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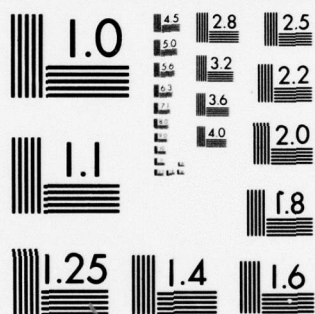
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# SIO REFERENCE SERIES

ADS REPORT NUMBER 2

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November, 1977

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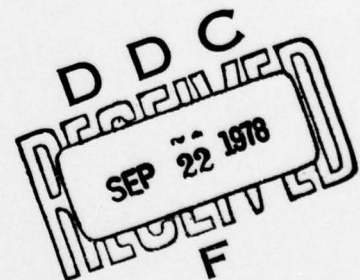
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## INTRODUCTION

During the Anomaly Dynamics Study (ADS) meeting of March 16, 1977 it was decided to produce a NORPAX ADS program data report for trimonthly periods roughly corresponding to seasons.

This is the second issue of that data report, covering the period from March, 1977 to May, 1977. This issue contains the same maps that were in the first report: contour maps of monthly mean FNWC air temperature, sea temperature, wind speed, wind direction, surface vapor pressure, and 700 mb heights; NORPAX Data Management calculated wind stress, wind stress curl, wind shear velocity cubed ( $U_*^3$ ), sensible heat flux, latent heat flux; objectively analyzed TRANSPAC temperatures at discrete depths from White and Bernstein (SIO); monthly ADS 1 buoy drifter tracks from Kirwan (TAMU) and McNally (SIO).

## PROCEDURE AND ANALYSIS

### 1. Contour Maps

Contour maps of FNWC fields and calculated flux fields are in Figures 4.1-4.11, 7.1-7.10, 10.1-10.11; TRANSPAC contour maps are in Figures 5, 8, 11. The 700 mb height field was missing in the April FNWC fields and therefore was not contoured that month.

Procedure and analysis of FNWC fields, NORPAX Data Management calculated flux fields, and TRANSPAC temperature anomalies were explained in the first issue of the ADS REPORT. No change has taken place since then.

The data fields were contoured using the SURFACE II contour plotting package at the Lawrence Berkeley Laboratory computer center. This package was originally written for the K.O.X. Project of the Kansas Geological Survey by Robert Sampson in 1973.\* It was used to grid data, smooth it, and contour plot the smoothed grid.

## 2. ADS 1 Buoy Tracks

Buoy tracks in Figures 2, 3, 6, 9, 12, calculated from satellite fixes, were plotted in this report instead of monthly buoy displacement. These buoys numbered from 15 to 19, and were drogued at 35 meters. Since the January and February, 1977, buoy vectors were not included in the first ADS REPORT, buoy tracks for those months are included here.

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\* Geological Research Section, Kansas Geological Survey, 1930 Avenue A, Campus West, The University of Kansas, Lawrence, Kansas 66044



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curl is the mean of 6-hourly wind stress curl approximated by finite-differences from 6-hourly wind stresses at 10 meters. Isolines of zero curl are plotted heavily, and contour intervals are  $4.0 \times 10^{-9}$  dynes/cm<sup>3</sup>.

Figure 4.5 The March mean wind shear stress velocity cubed,  $U_*^3$  is the mean of 6-hourly wind shear stress velocity cubed calculated from wind speed at 10 meters. Contour intervals are  $0.02 \text{ (m/sec)}^3$ .

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Figure 4.11 The March mean latent heat flux (ocean to atmosphere) is the mean of 12-hourly latent heat flux calculated from FNWC sea temperature, vapor pressure and wind using a bulk formula. Isolines of zero heat flux are plotted heavily, and contour intervals are  $0.5 \times 10^{-3} \text{ cal/cm}^2 \text{ sec.}$

Figure 5 The March temperature anomalies ( $^{\circ}\text{C}$ ) contoured at fixed depths. Negative anomaly areas are hatchured and isolines of zero anomaly are drawn heavily. The crosses mark the positions of the TRANSPAC XBT drops. Increments are in  $.1^{\circ}\text{C}$ . (Prepared by W. White, SIO.)

Figure 6 The March buoy tracks. Tracks are drawn from starting point at beginning of month to terminal point at end of month. Ratio of latitude to longitude is the same as in other figures. (Prepared by D. Kirwan, TAMU.)

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2.5 knots, 1/2 vane is plotted.

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Figure 7.9 The April mean sensible heat flux (ocean to atmos-



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Figure 7.10 The April mean latent heat flux (ocean to atmosphere) is the mean of 12-hourly latent heat flux calculated from FNWC sea temperature, vapor pressure and wind using a bulk formula. Isolines of zero heat flux are plotted heavily, and contour intervals are  $0.5 \times 10^{-3} \text{ cal/cm}^2 \text{ sec.}$

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Figure 9 The April buoy tracks. Tracks are drawn from starting point at beginning of month to terminal point at end of month. Ratio of latitude to longitude is the same as in other figures. (Prepared by D. Kirwan, TAMU.)

Figure 10.1 Absolute value of the May mean vector wind velocities at 19.5 meters. Contour intervals are 1 m/sec.

Figure 10.2 Direction arrows representing directions of the May mean wind vectors at 19.5 meters. Vanes on arrows

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Figure 10.8 The May mean 700 mb height is the mean of 12-hourly FNWC 700 mb heights. Contour intervals are 25

meters.

Figure 10.9 The May mean surface vapor pressure is the mean of 12-hourly FNWC vapor pressure at 19.5 meters. Contour intervals are 1 mb.

Figure 10.10 The May mean sensible heat flux (ocean to atmosphere) is the mean of 12-hourly sensible heat flux calculated from FNWC air and sea temperature and wind using a bulk formula. Isolines of zero heat flux are plotted heavily, and contour intervals are  $1.0 \times 10^{-4} \text{ cal/cm}^2 \text{ sec.}$

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Figure 11 The May temperature anomalies ( $^{\circ}\text{C}$ ) contoured at fixed depths. Negative anomaly areas are hatchured and isolines of zero anomaly are drawn heavily. The crosses mark the positions of the TRANSPAC XBT drops. Increments are in  $.1^{\circ}\text{C}$ . (Prepared by W. White, SIO.)

Figure 12 The May buoy tracks. Tracks are drawn from starting point at beginning of month to terminal point at end of month. Ratio of latitude to longitude is the same as in other figures. (Prepared by D. Kirwan, TAMU.)



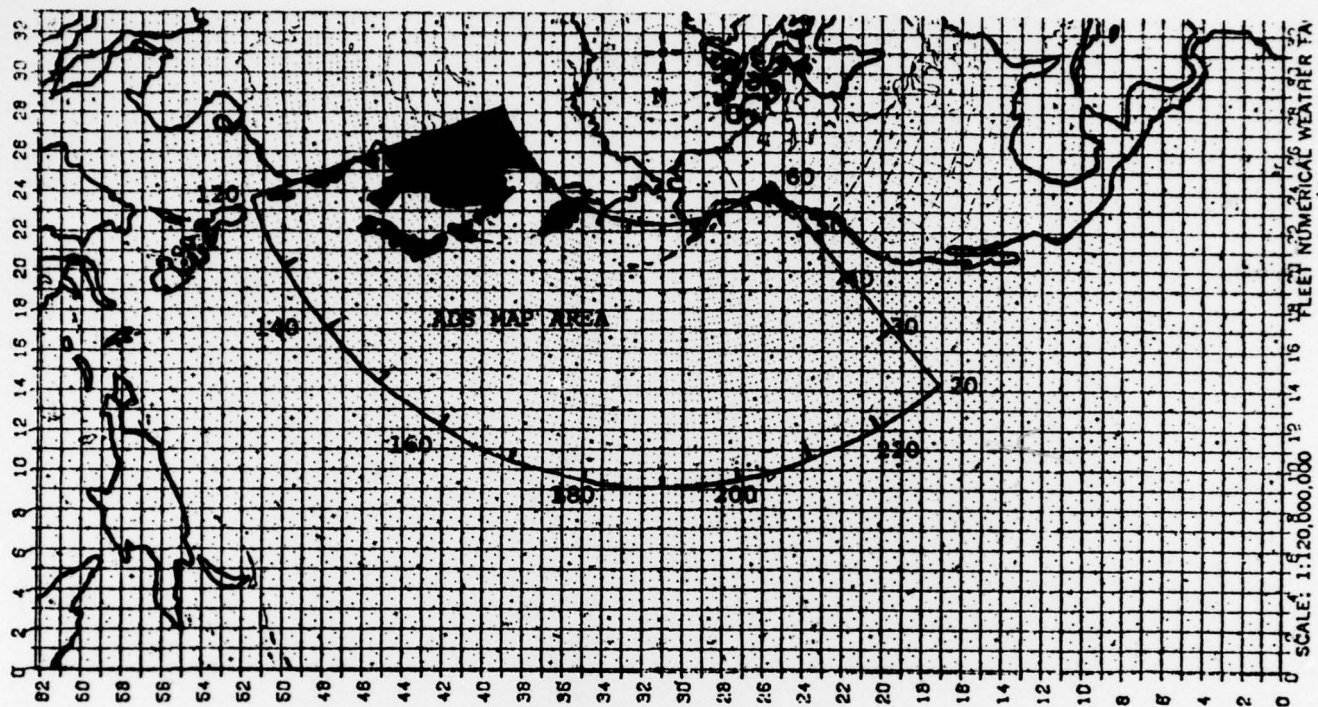


FIGURE 1. 33 x 63 field geographic coverage. The area of the ADS contour maps is as indicated. This map is a polar projection of the northern hemisphere.



Jan. 1, 1977 to Jan. 31, 1977

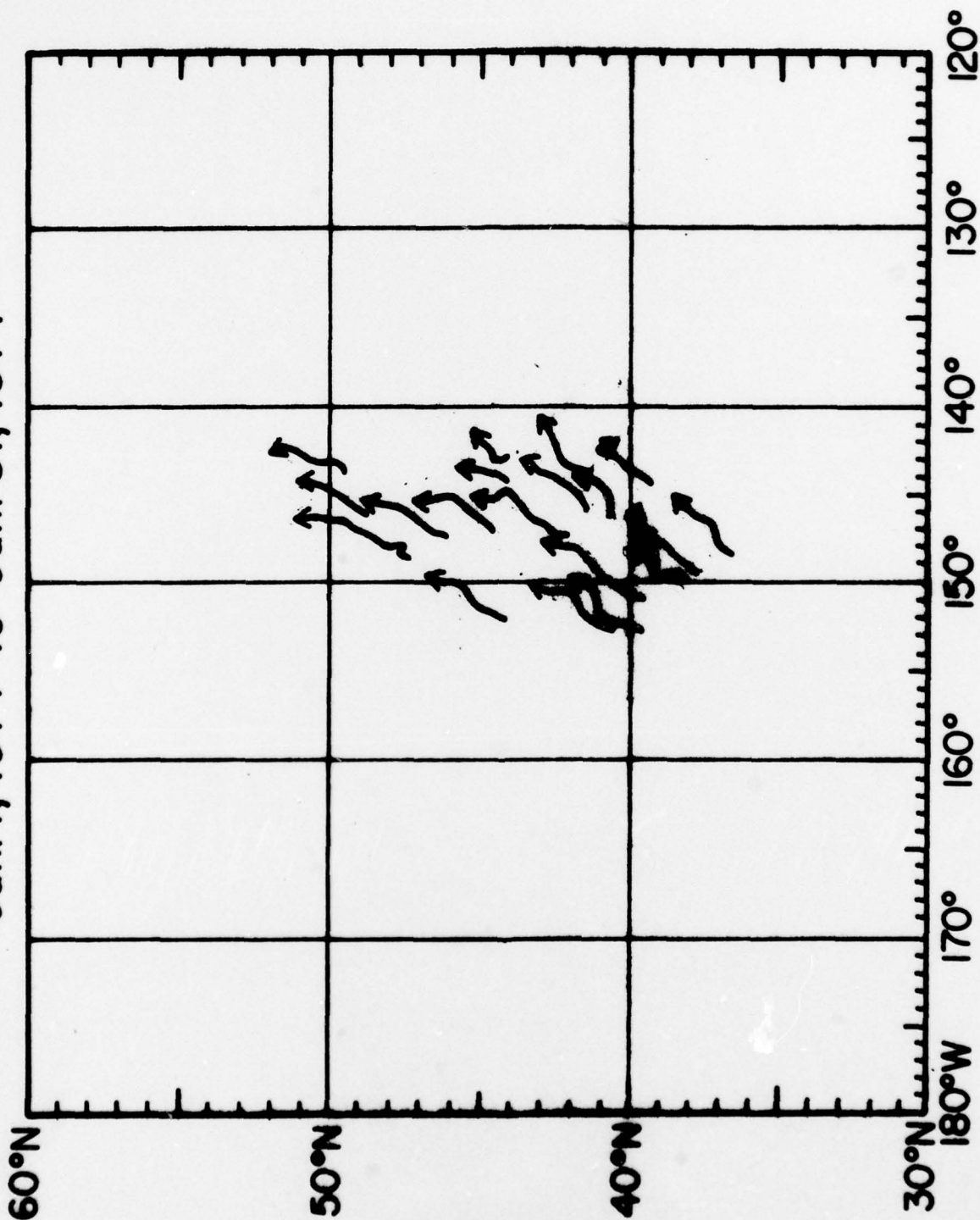


FIGURE 2. Monthly buoy tracks. Tracks are drawn from starting point at beginning of month to terminal point at end of month. Ratio of latitude to longitude is the same as in other figures (prepared by D. Kirwan, TAMU).

Feb. 1, 1977 to Feb. 28, 1977

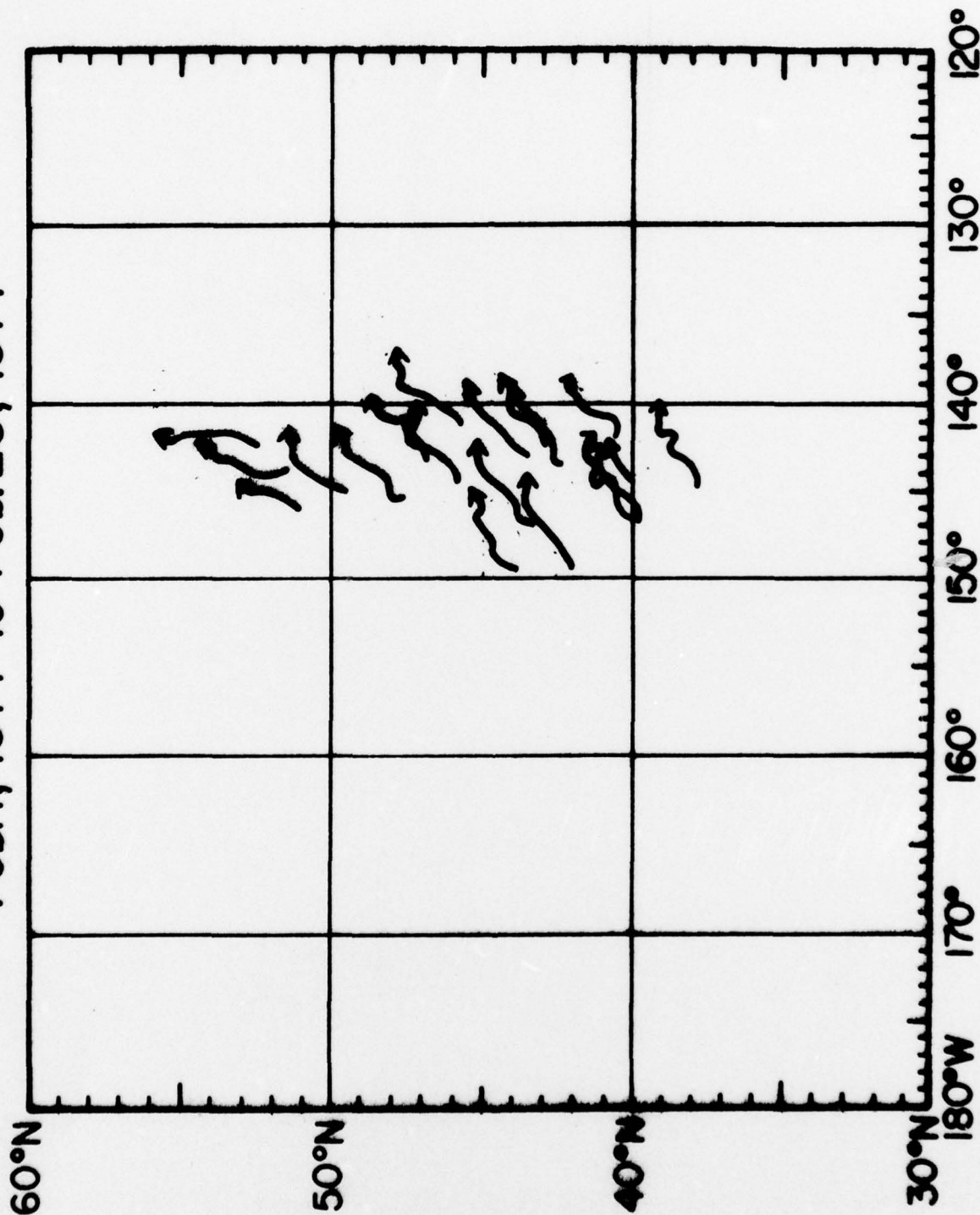


FIGURE 3. Monthly buoy tracks. Tracks are drawn from starting point at beginning of month to terminal point at end of month. Ratio of latitude to longitude is the same as in other figures. (Prepared by D. Kirwan TAMU.)

WIND SPEED (M/SEC)

MAR 77

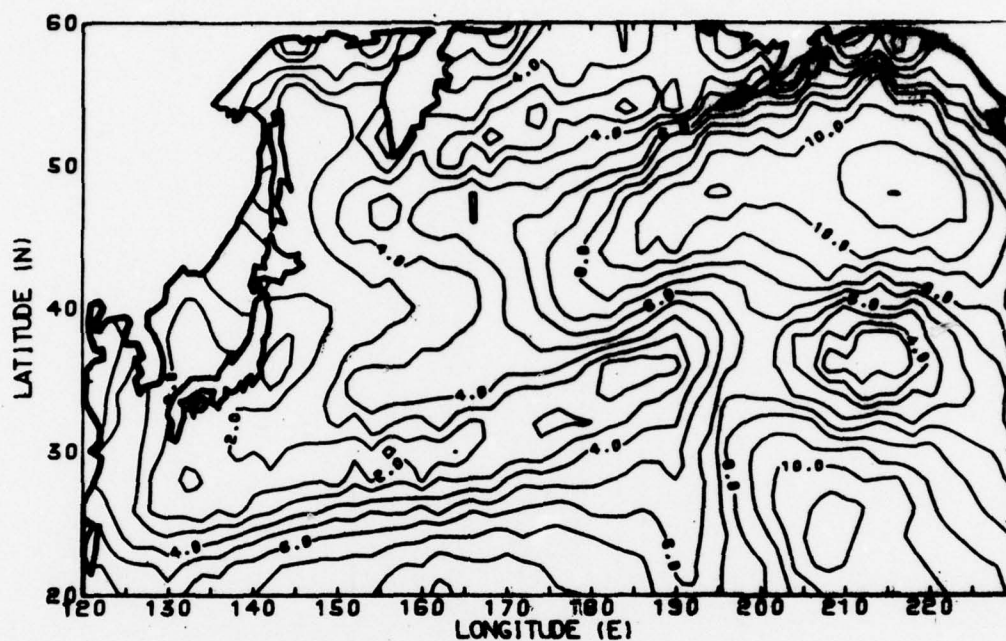


FIGURE 4.1 Absolute value of monthly mean vector wind velocities at 19.5 meters. Contour intervals are 1 m/sec.

WIND DIRECTION

MAR 77

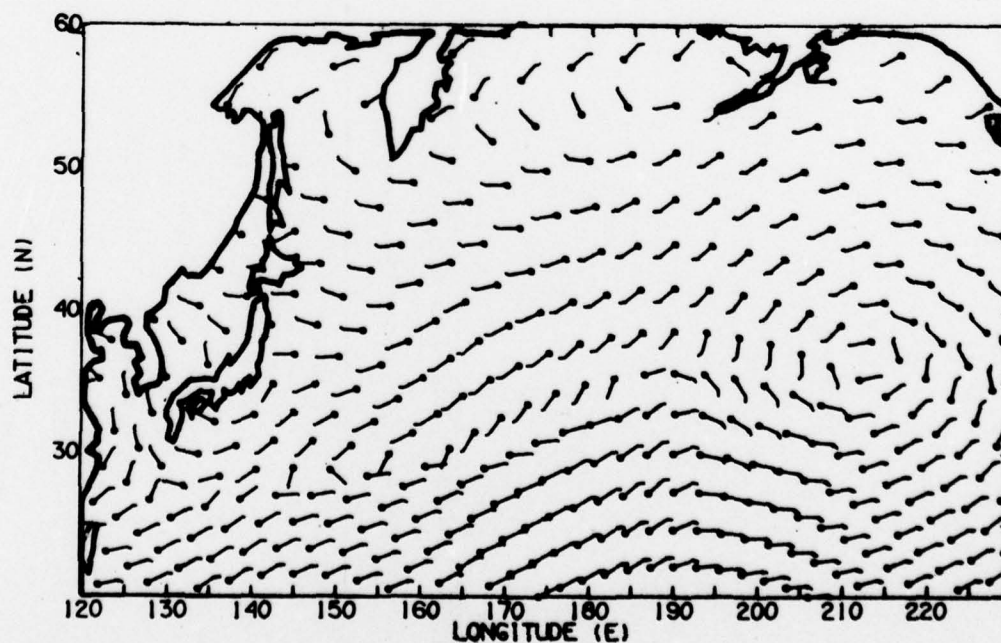


FIGURE 4.2 Direction arrows representing directions of monthly mean wind vectors at 19.5 meters. Vanes on arrows indicate wind speed in knots. If speed is less than 2.5 knots, there is no vane; for every 5 knots above 2.5 knots, 1/2 vane is plotted.



# WIND STRESS (DYNES/CM<sup>2</sup>)

MAR 77

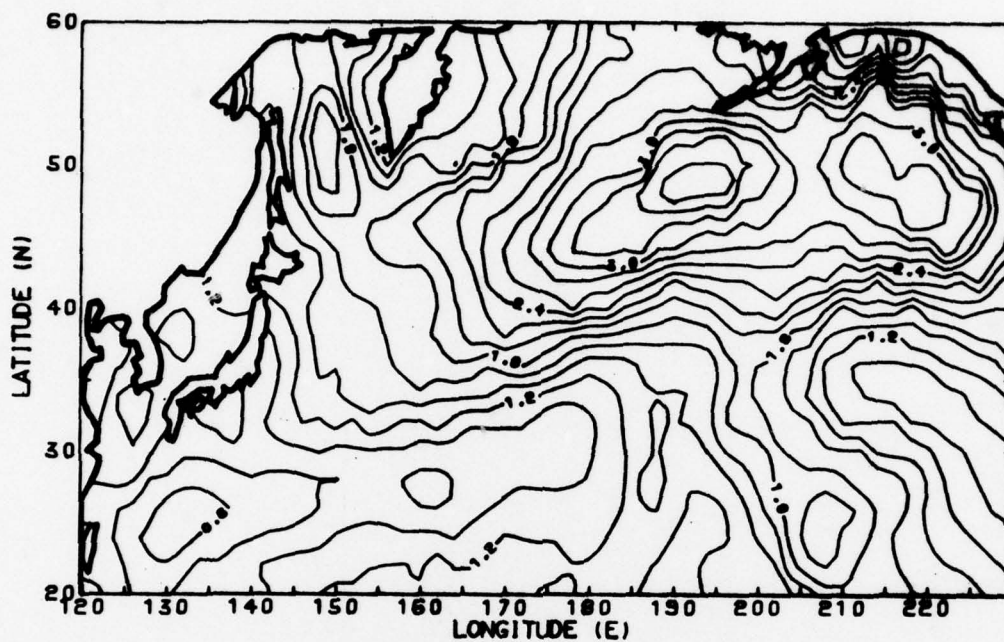


FIGURE 4.3 Monthly mean wind stress is the mean of 6-hourly wind stress at 10 meters calculated from FNWC wind data. Contour intervals are 0.2 dynes/cm<sup>2</sup>.

# CURL OF WIND STRESS (10<sup>-9</sup> DYNES/CM<sup>3</sup>)

MAR 77

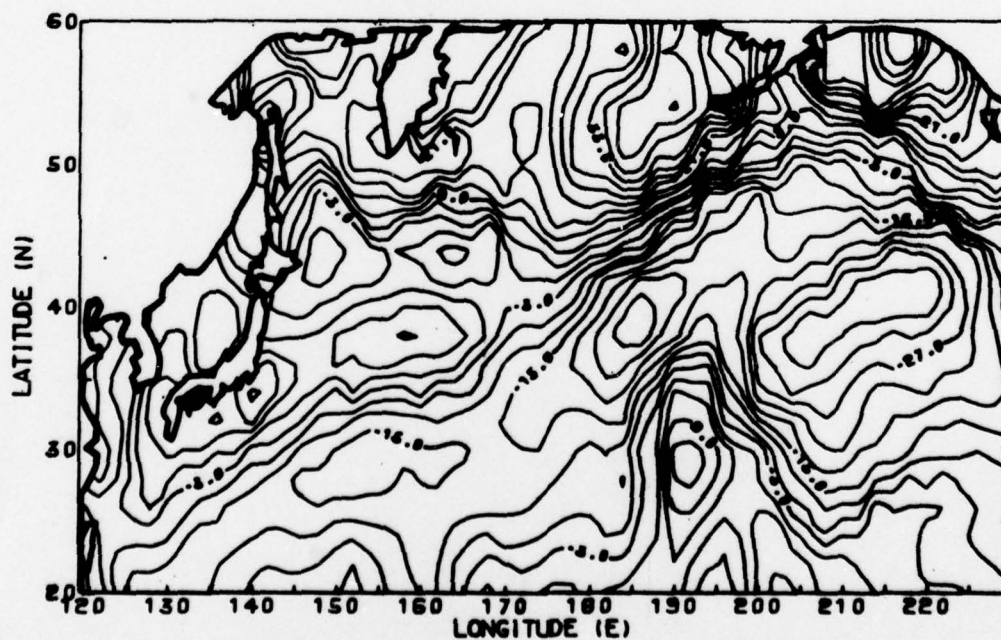


FIGURE 4.4 The vertical component of monthly mean wind stress curl is the mean of 6-hourly wind stress curl approximated by finite-differences from 6-hourly wind stresses at 10 meters. Isolines of zero curl are plotted heavily, and contour intervals are  $4.0 \times 10^{-9}$  dynes/cm<sup>3</sup>.



U STAR CUBED ((M/SEC)\*\*3)

MAR 77

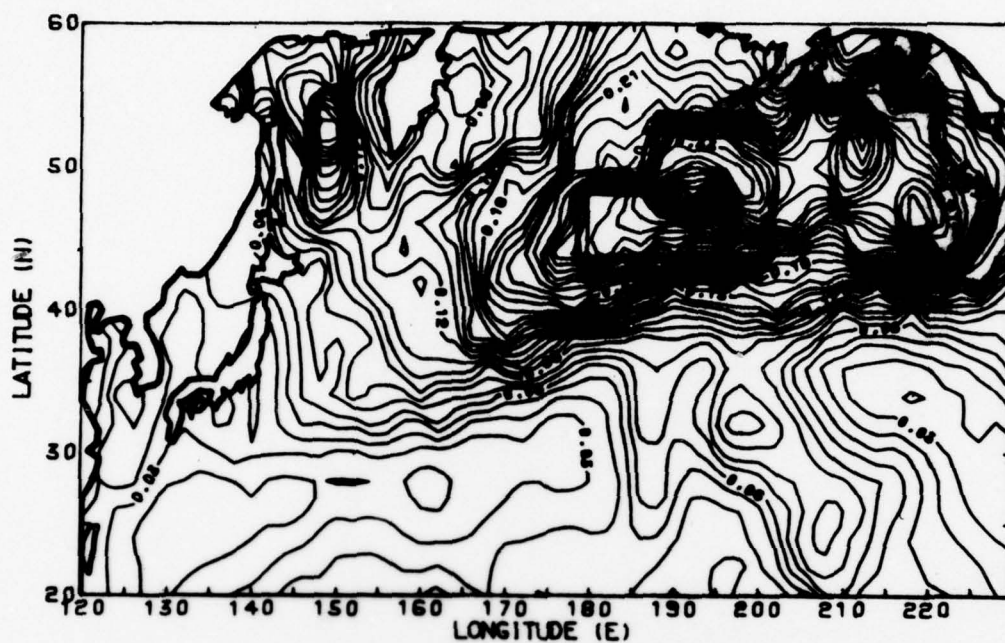


FIGURE 4.5 Monthly mean wind shear stress velocity cubed,  $U_*^3$  is the mean of 6-hourly wind shear stress velocity cubed calculated from wind speed at 10 meters. Contour intervals are 0.02 (m/sec)<sup>3</sup>.

SEA SURFACE TEMPERATURE (DEG.C)

MAR 77

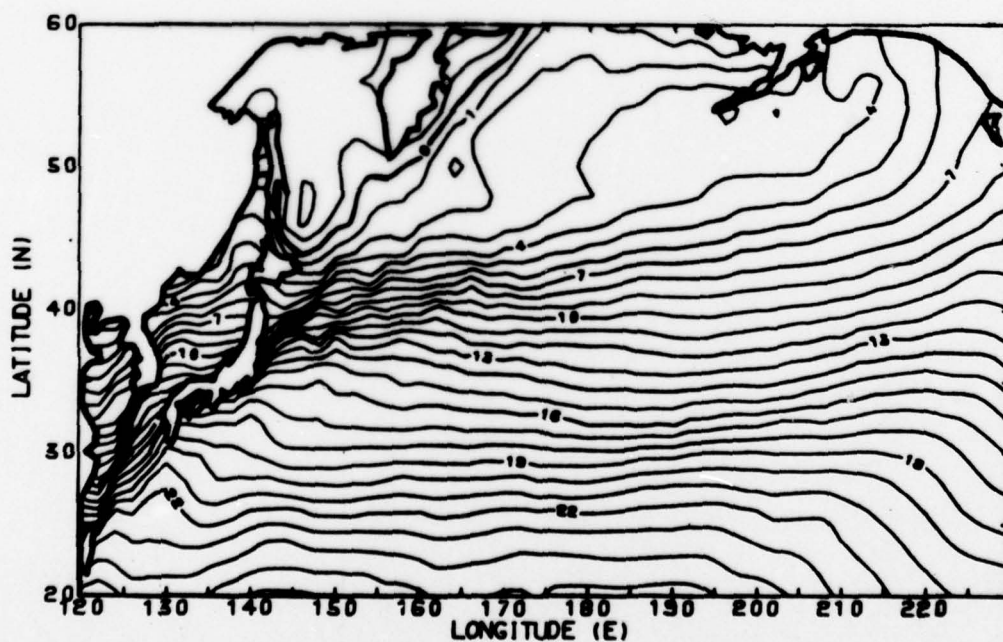


FIGURE 4.6 Monthly mean sea surface temperature is the mean of 12-hourly FNWC sea surface temperatures. Contour intervals are 1°C.

AIR TEMPERATURE (DEG. C) MAR 77

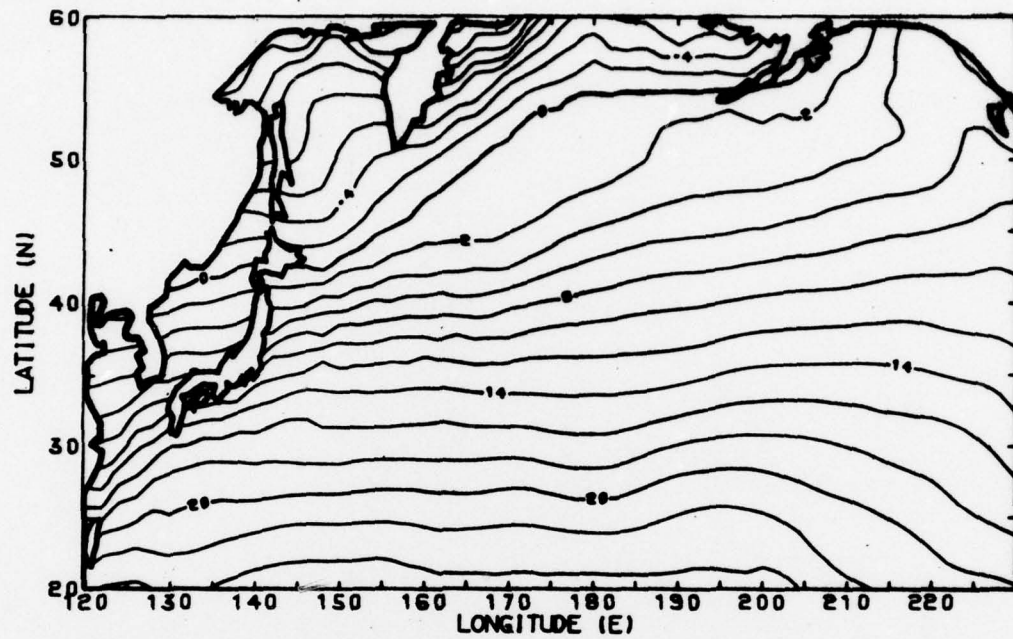


FIGURE 4.7 Monthly mean air temperature is the mean of 12-hourly FNWC air temperatures. Contour intervals are 2°C.

700 MB HEIGHT (M) MAR 77

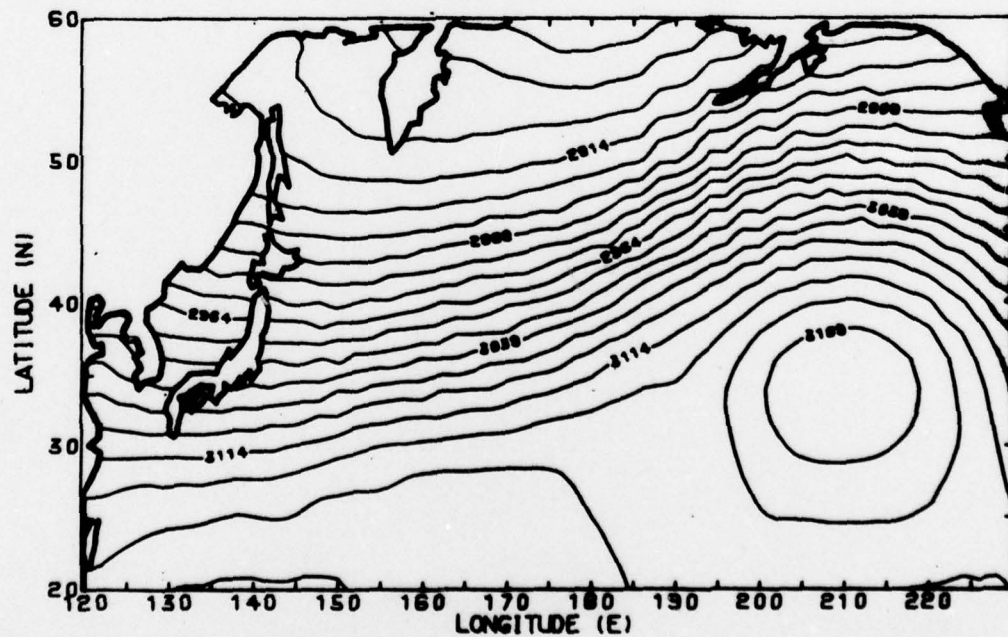


FIGURE 4.8 Monthly mean 700 mb height is the mean of 12-hourly FNWC 700 mb heights. Contour intervals are 25 meters.

VAPOR PRESSURE (MB) MAR 77

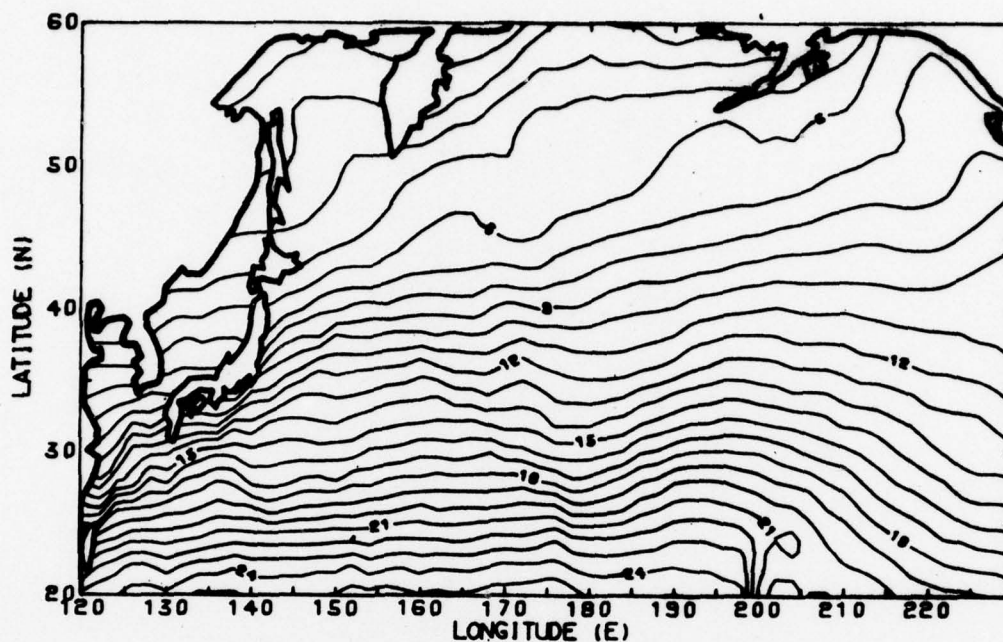


FIGURE 4.9 Monthly mean surface vapor pressure is the mean of 12-hourly FNWC vapor pressure at 19.5 meters. Contour intervals are 1 mb.

SENSIBLE HEAT FLUX ( $10^{-4}$  CAL/CM<sup>2</sup> SEC) MAR 77

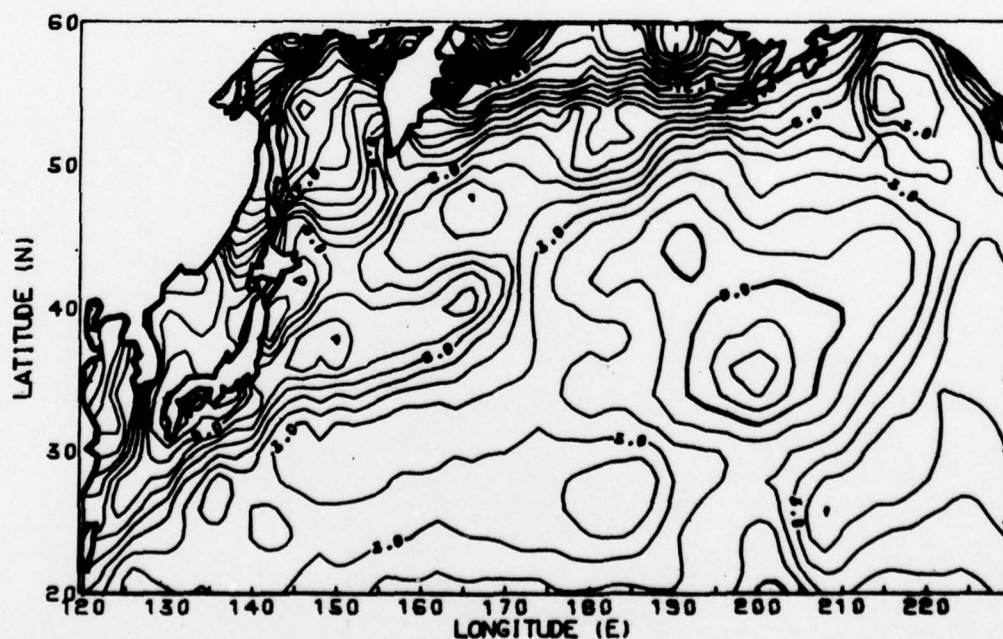


FIGURE 4.10 Monthly mean sensible heat flux (ocean to atmosphere) is the mean of 12-hourly sensible heat flux calculated from FNWC air and sea temperature and wind using a bulk formula. Isolines of zero heat flux are plotted heavily, and contour intervals are  $1.0 \times 10^{-4}$  cal/cm<sup>2</sup> sec.



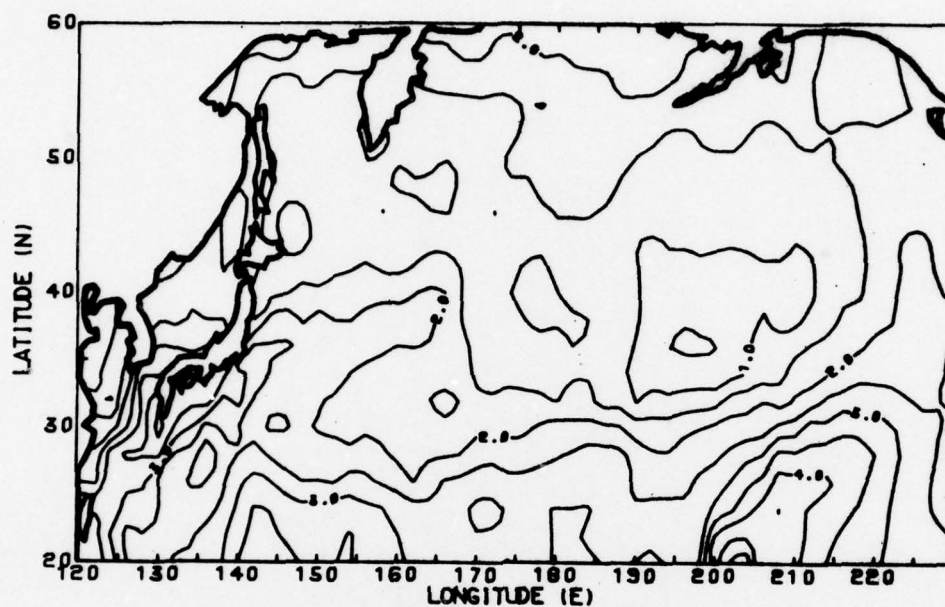
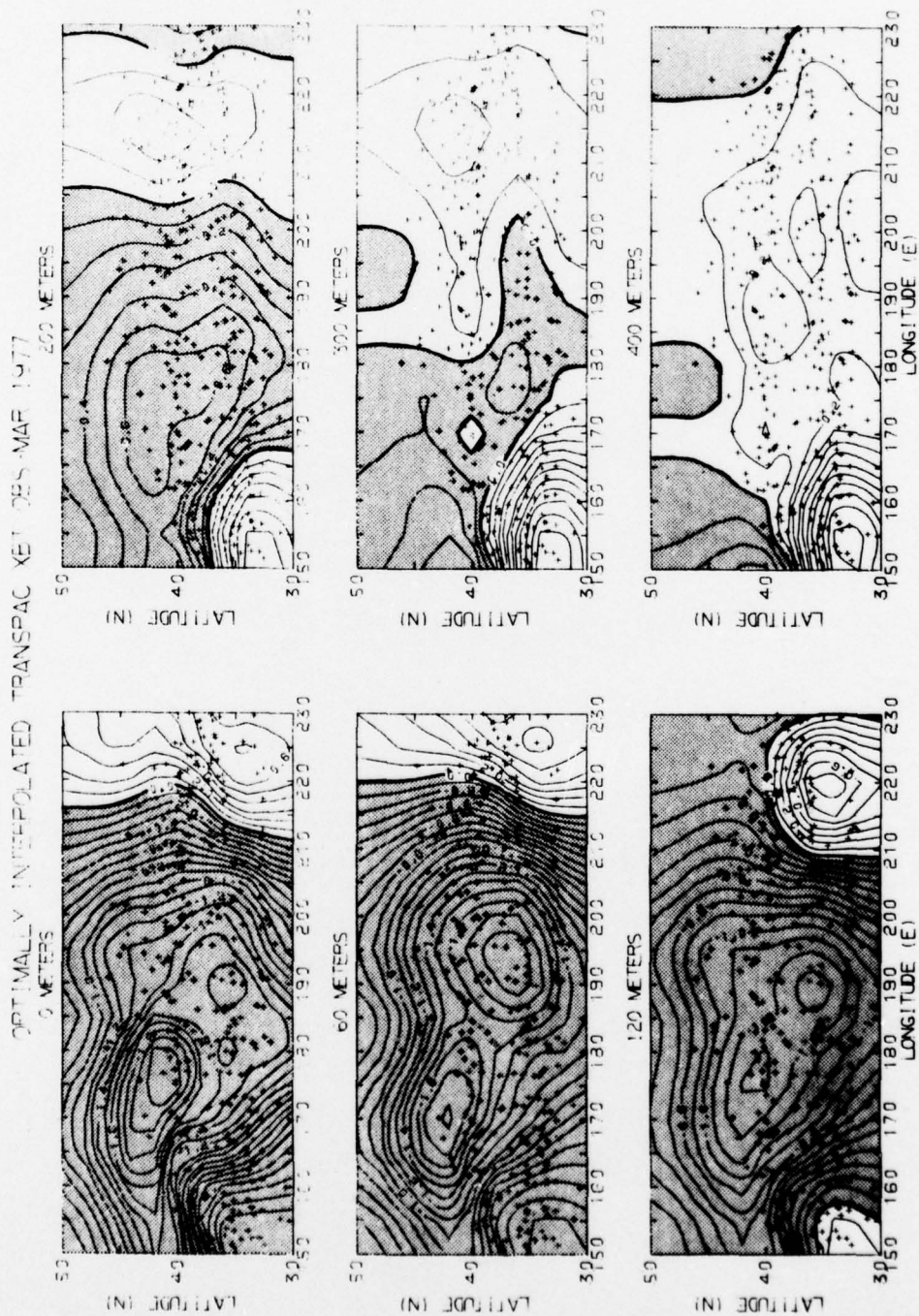


FIGURE 4.11 Monthly mean latent heat flux (ocean to atmosphere) is the mean of 12-hourly latent heat flux calculated from FNWC sea temperature, vapor pressure and wind using a bulk formula. Isolines of zero heat flux are plotted heavily, and contour intervals are  $0.5 \times 10^{-3}$  cal/cm $^2$  sec.





**FIGURE 5.** Monthly temperature anomalies ( $^{\circ}\text{C}$ ) contoured at fixed depths. Negative anomaly areas are hatched and isolines of zero anomaly are drawn heavily. The crosses mark the positions of the TRANSPAC XBT drops. Increments are in  $.1^{\circ}\text{C}$ . (Prepared by W. White, SIO.)

Mar. 1, 1977 to Mar. 31, 1977

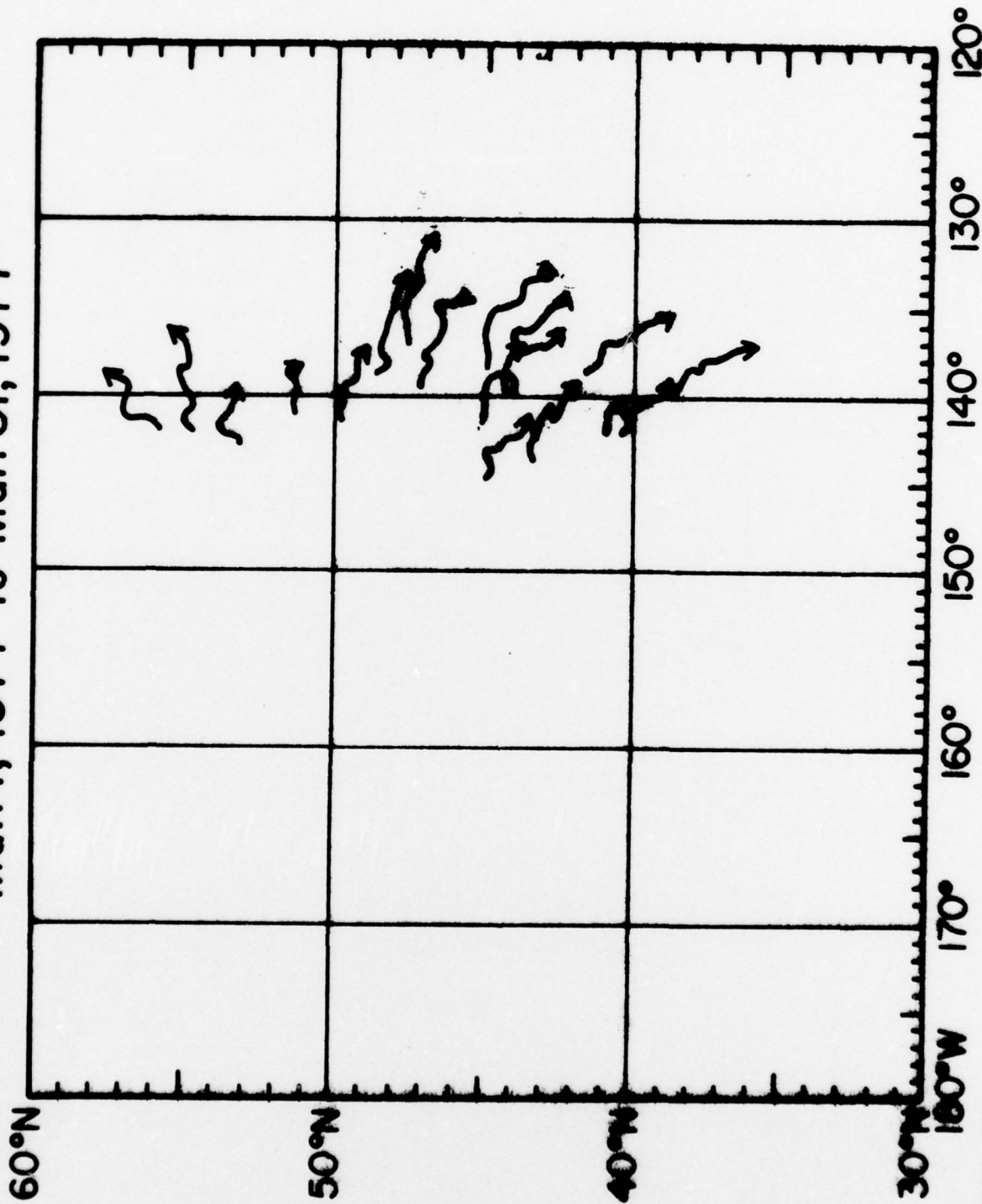


FIGURE 6. Monthly buoy tracks. Tracks are drawn from starting point at beginning of month to terminal point at end of month. Ratio of latitude to longitude is the same as in other figures (prepared by D. Kirwan, TAMU).

WIND SPEED (M/SEC)

APR 77

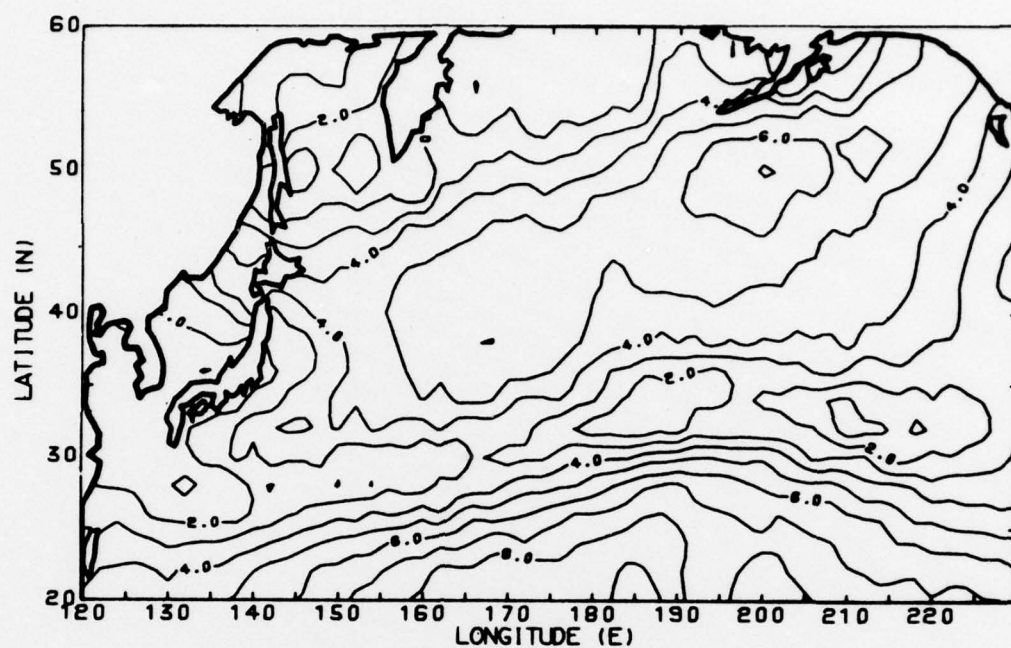


FIGURE 7.1 Absolute value of monthly mean vector wind velocities at 19.5 meters. Contour intervals are 1 m/sec.

WIND DIRECTION

APR 77

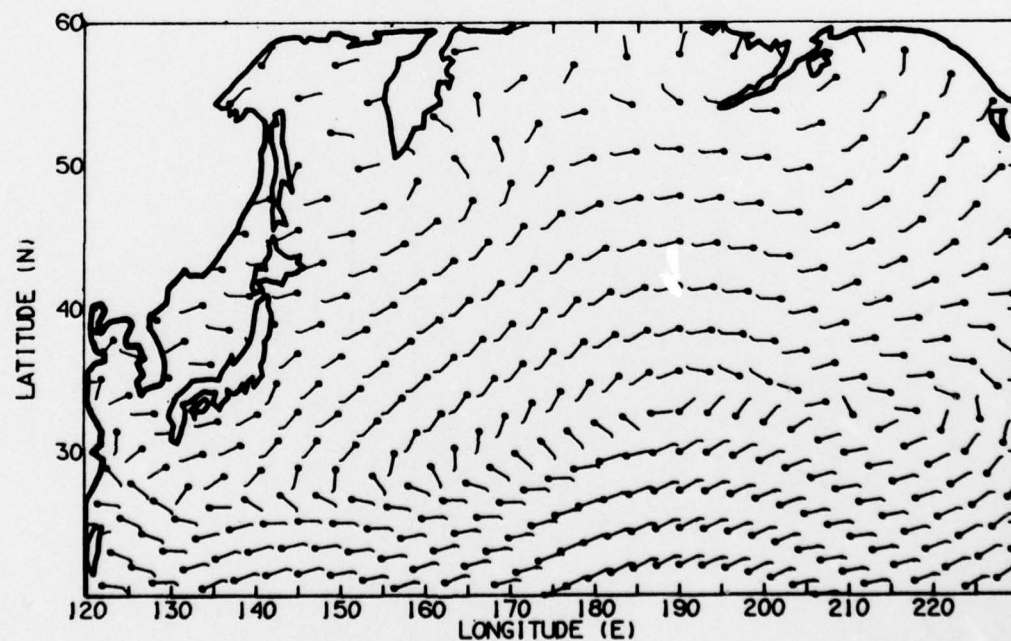


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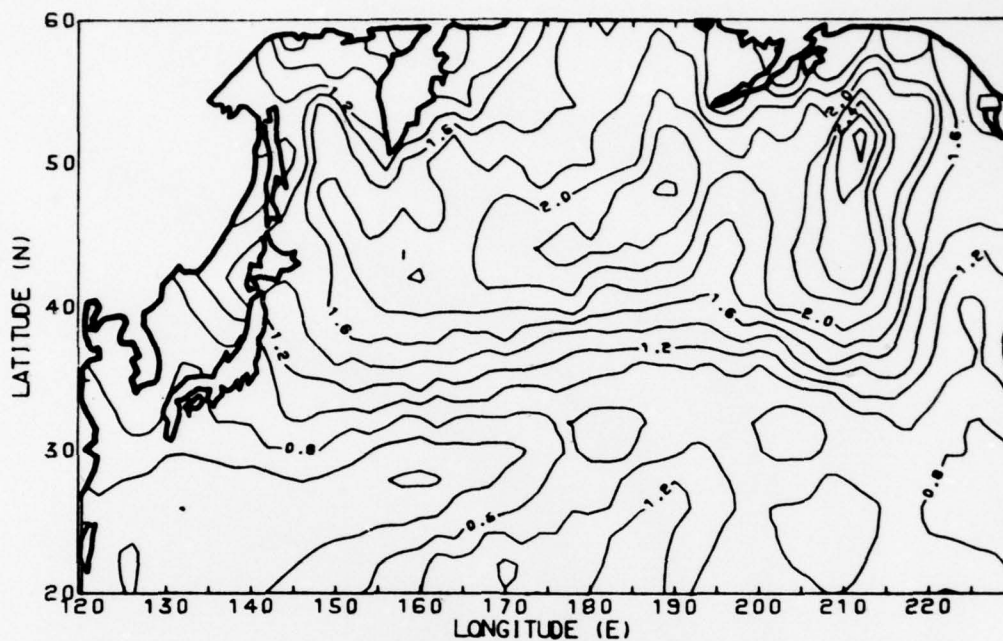


FIGURE 7.3 Monthly mean wind stress is the mean of 6-hourly wind stress at 10 meters calculated from FNWC wind data. Contour intervals are 0.2 dynes/cm<sup>2</sup>.

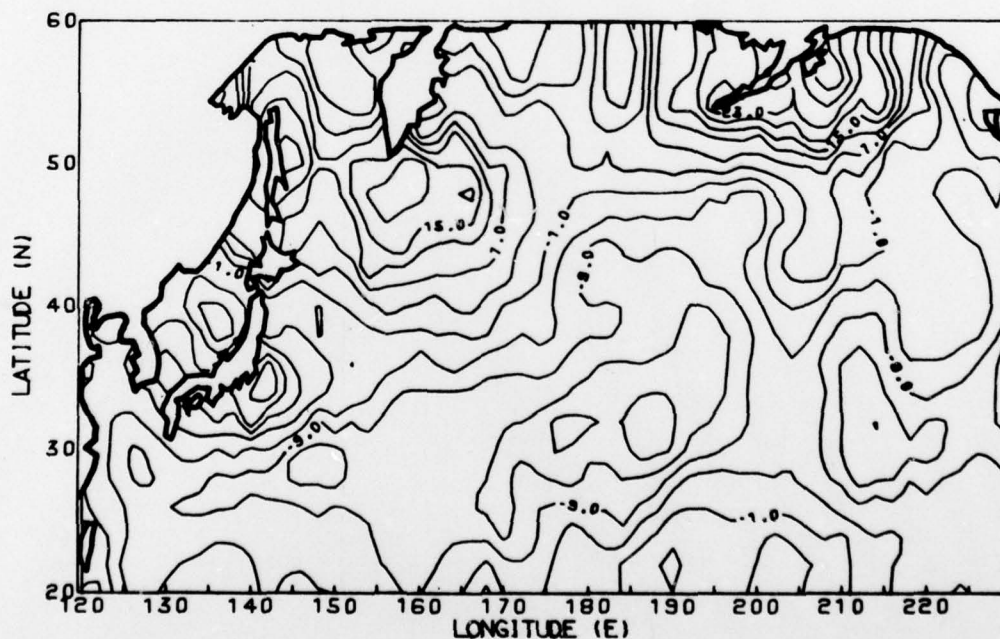


FIGURE 7.4 The vertical component of monthly mean wind stress curl is the mean of 6-hourly wind stress curl approximated by finite-differences from 6-hourly wind stresses at 10 meters. Isolines of zero curl are plotted heavily, and contour intervals are 4.0 x 10<sup>•••9</sup> dynes/cm<sup>••3</sup>.



U STAR CUBED ((M/SEC)\*\*3)

APR 77

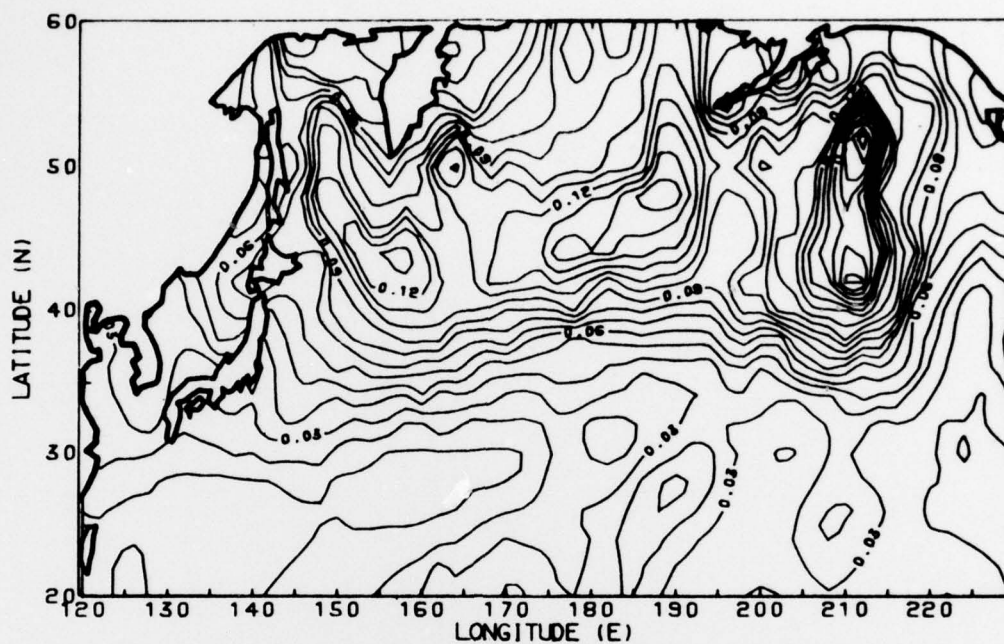


FIGURE 7.5 Monthly mean wind shear stress velocity cubed,  $U_*^3$  is the mean of 6-hourly wind shear stress velocity cubed calculated from wind speed at 10 meters. Contour intervals are  $0.02 (m/sec)^3$ .

SEA SURFACE TEMPERATURE (DEG.C)

APR 77

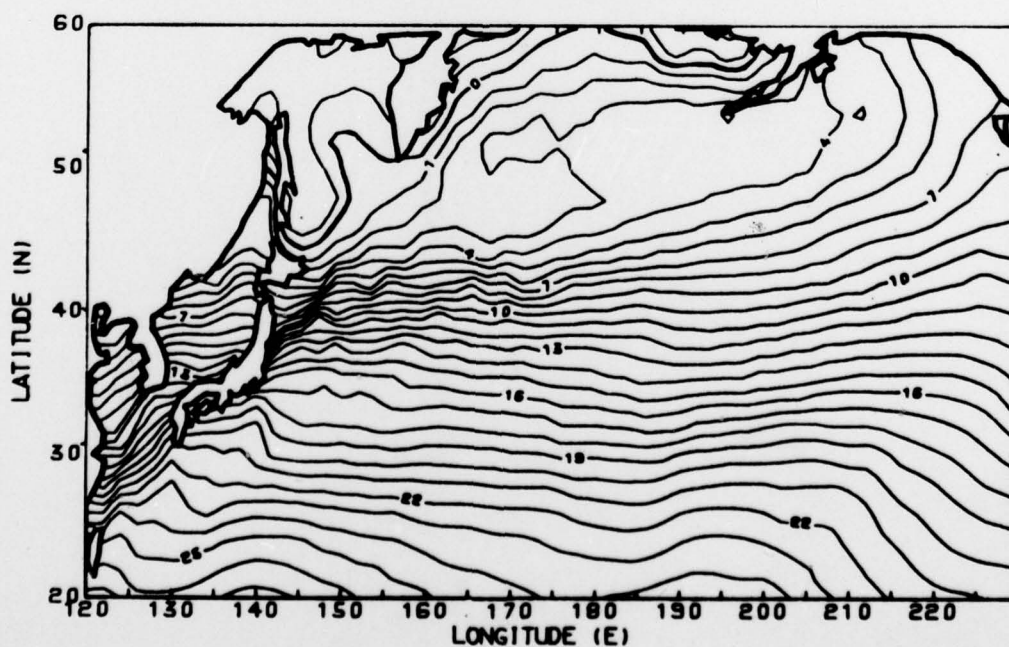


FIGURE 7.6 Monthly mean sea surface temperature is the mean of 12-hourly FNWC sea surface temperatures. Contour intervals are  $1^{\circ}C$ .

AIR TEMPERATURE (DEG. C)      APR    77

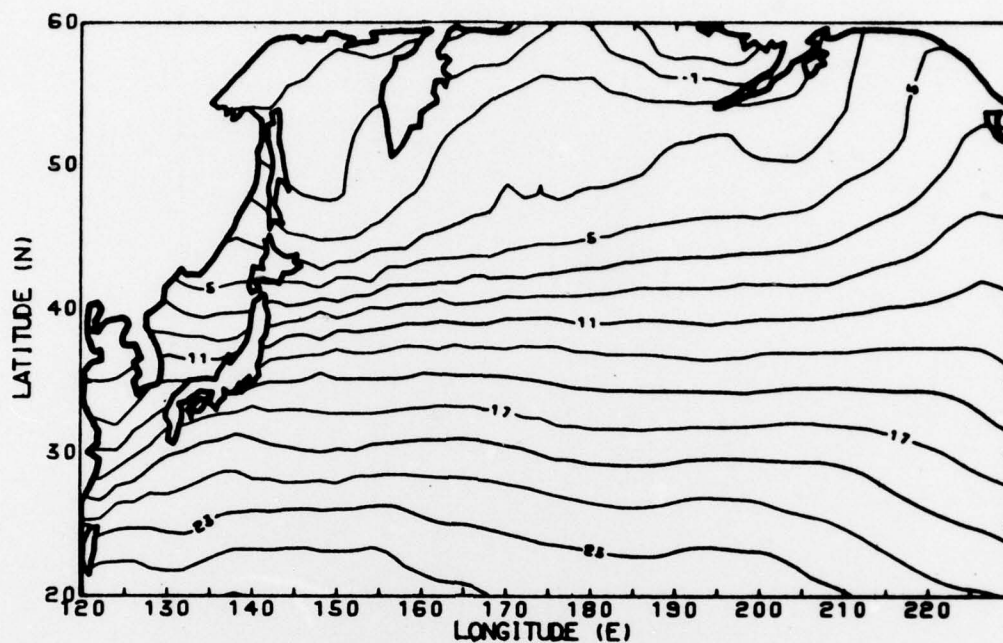


FIGURE 7.7      Monthly mean air temperature is the mean of 12-hourly FNWC air temperatures. Contour intervals are 2°C.

VAPOR PRESSURE (MB)      APR    77

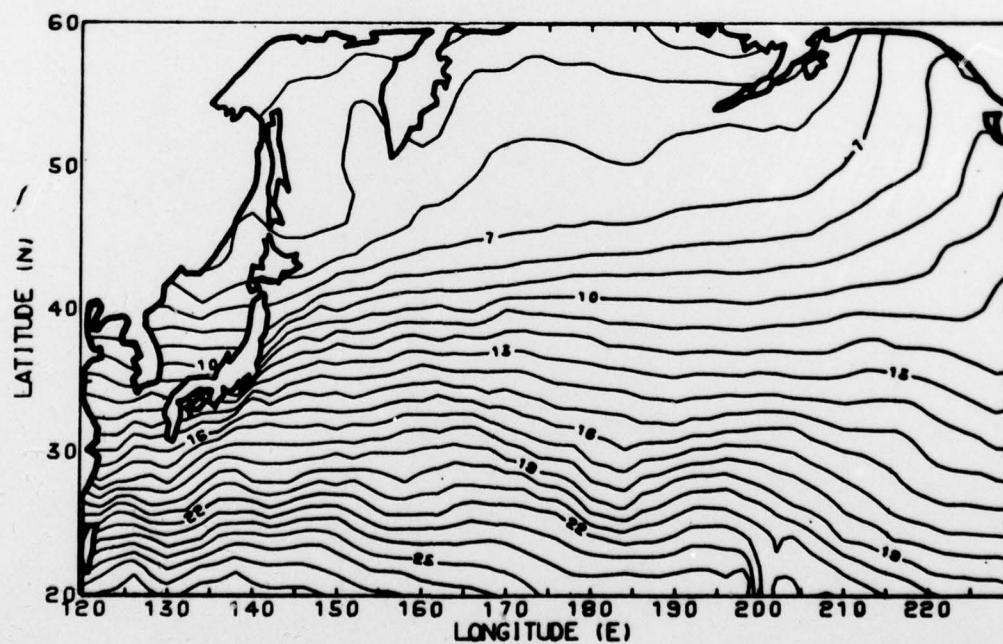


FIGURE 7.8      Monthly mean surface vapor pressure is the mean of 12-hourly FNWC vapor pressure at 19.5 meters. Contour intervals are 1 mb.

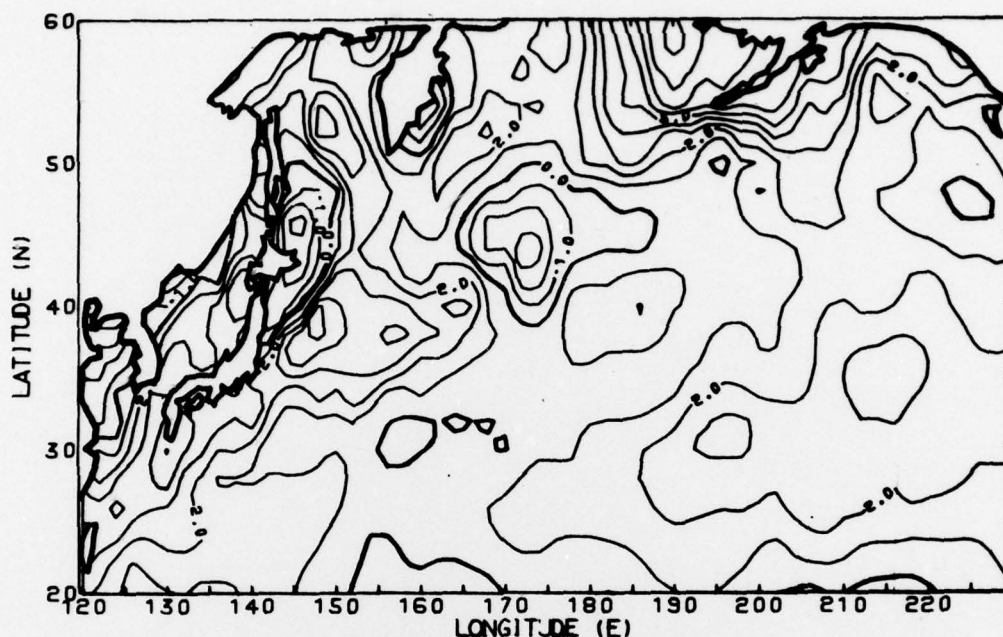


FIGURE 7.9 Monthly mean sensible heat flux (ocean to atmosphere) is the mean of 12-hourly sensible heat flux calculated from FNWC air and sea temperature and wind using a bulk formula. Isolines of zero heat flux are plotted heavily, and contour intervals are  $1.0 \times 10^{-4}$  cal/cm $^2$  sec.

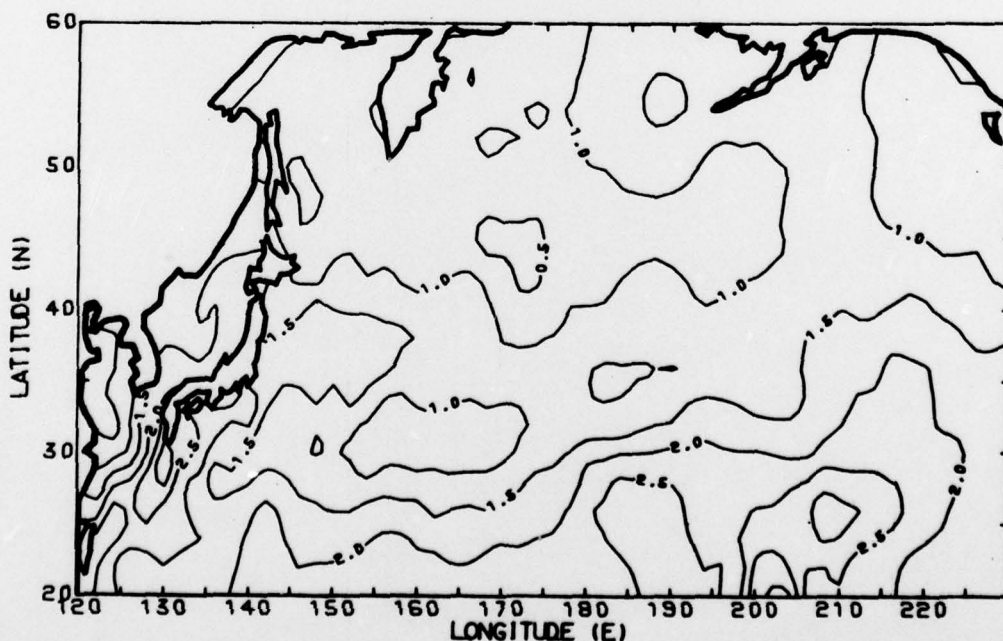
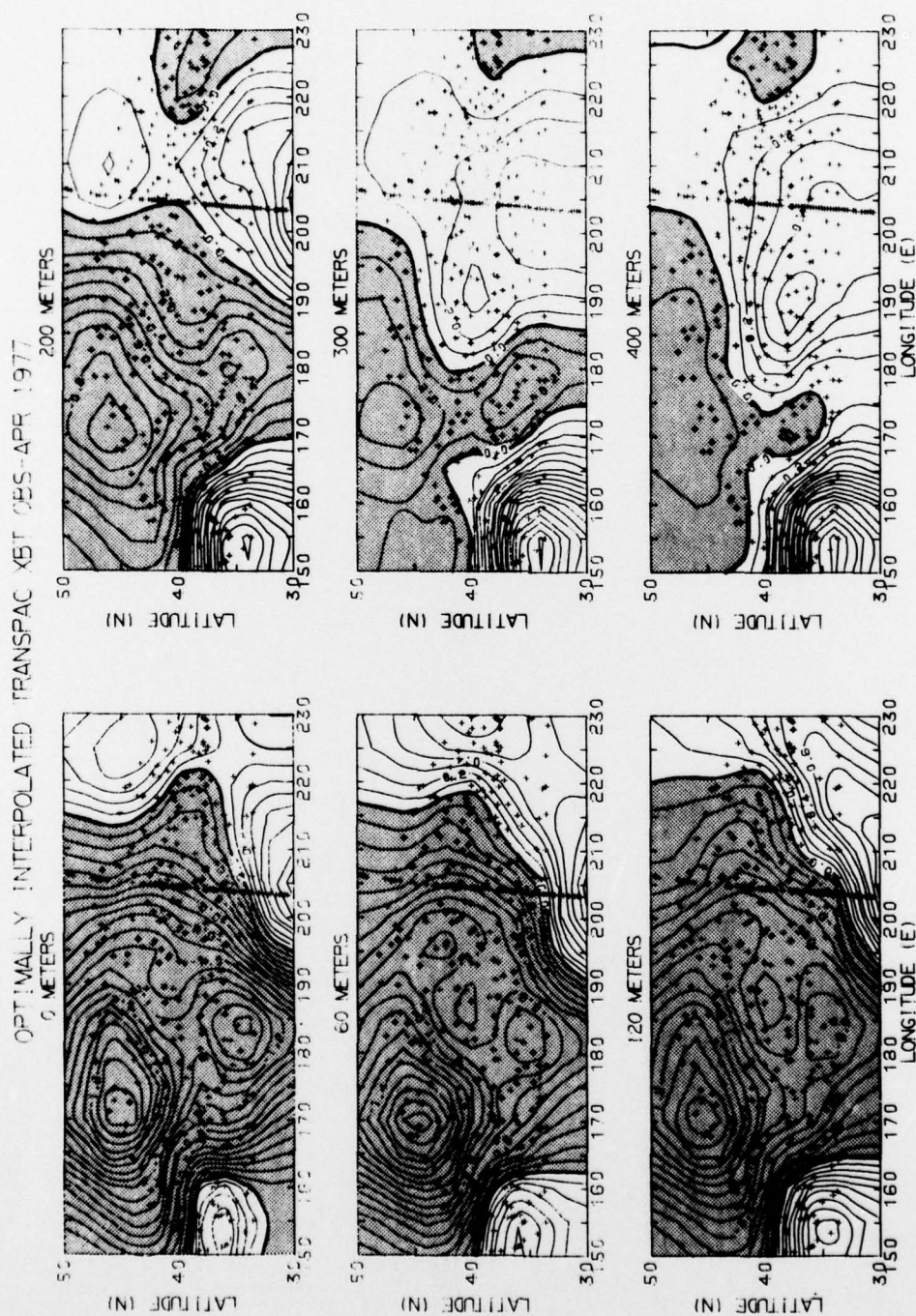


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**FIGURE 8.** Monthly temperature anomalies ( $^{\circ}\text{C}$ ) contoured at fixed depths. Negative anomaly areas are hatched and isolines of zero anomaly are drawn heavily. The crosses mark the positions of the TRANSPAC XBT drops. Increments are in  $.1^{\circ}\text{C}$  (prepared by W. White, SIO).



Apr. 1, 1977 to Apr. 30, 1977

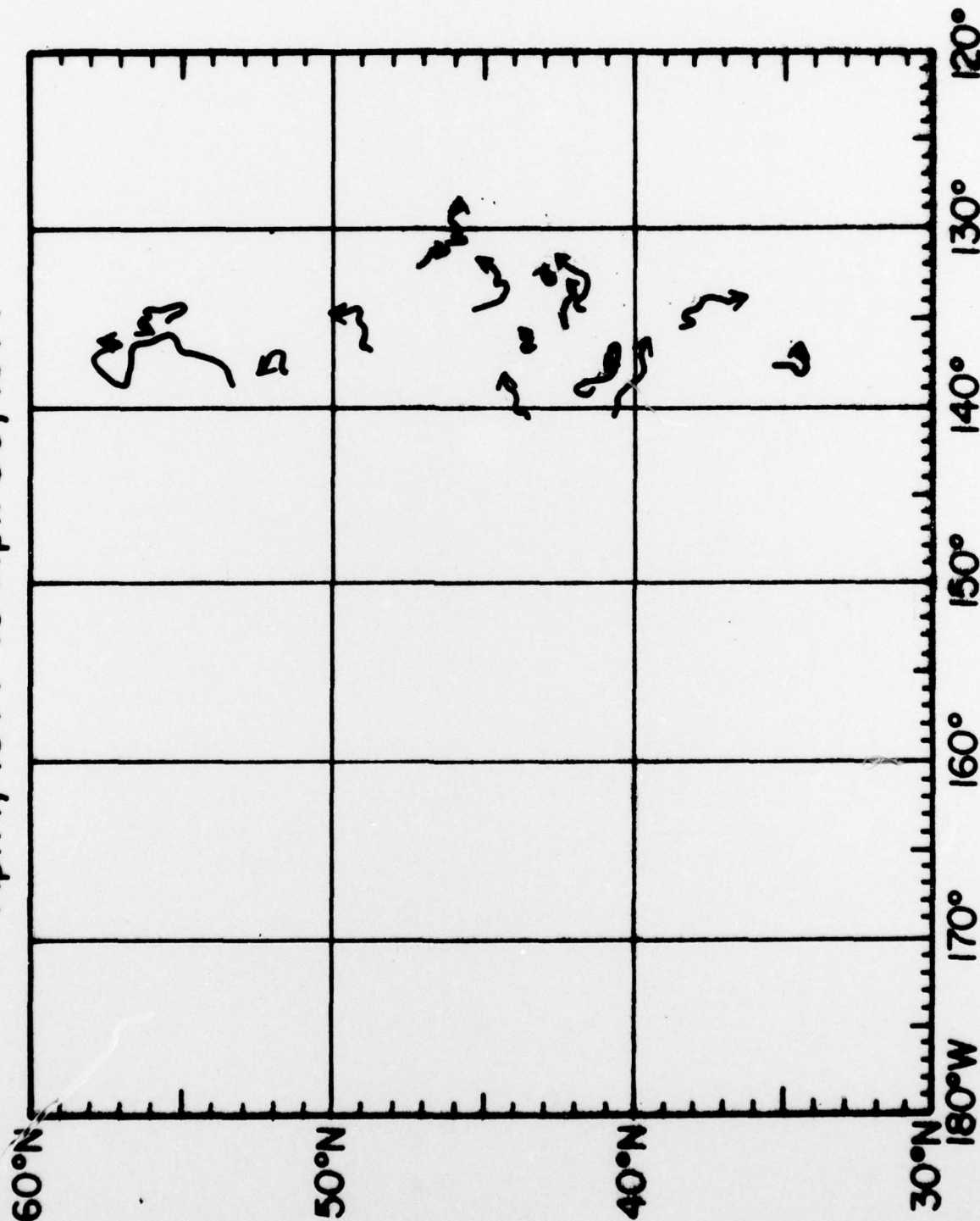


FIGURE 9. Monthly buoy tracks. Tracks are drawn from starting point at beginning of month to terminal point at end of month. Ratio of latitude to longitude is the same as in other figures (prepared by D. Kirwan, TAMU).

WIND SPEED (M/SEC)

MAY 77

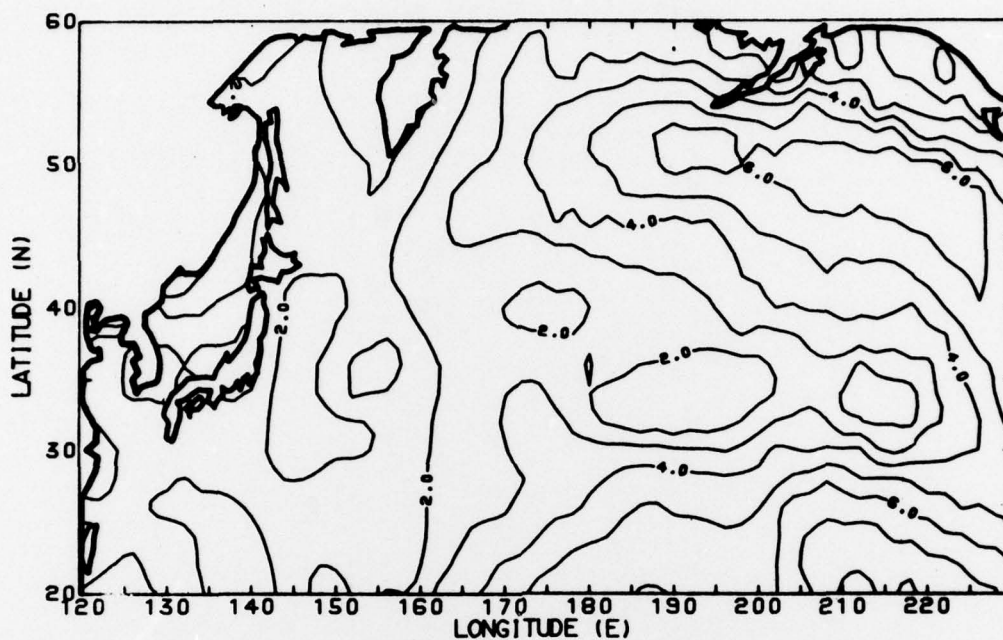


FIGURE 10.1 Absolute value of monthly mean vector wind velocities at 19.5 meters. Contour intervals are 1 m/sec.

WIND DIRECTION

MAY 77

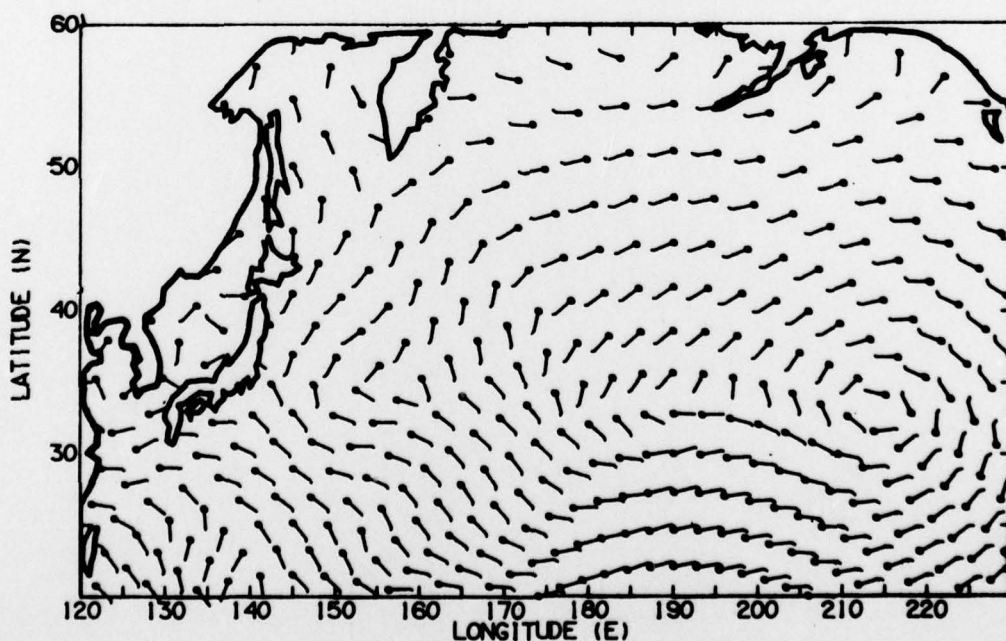


FIGURE 10.2 Direction arrows representing directions of monthly mean wind vectors at 19.5 meters. Vanes on arrows indicate wind speed in knots. If speed is less than 2.5 knots, there is no vane; for every 5 knots above 2.5 knots, 1/2 vane is plotted.

WIND STRESS (DYNES/CM<sup>••2</sup>)

MAY 77

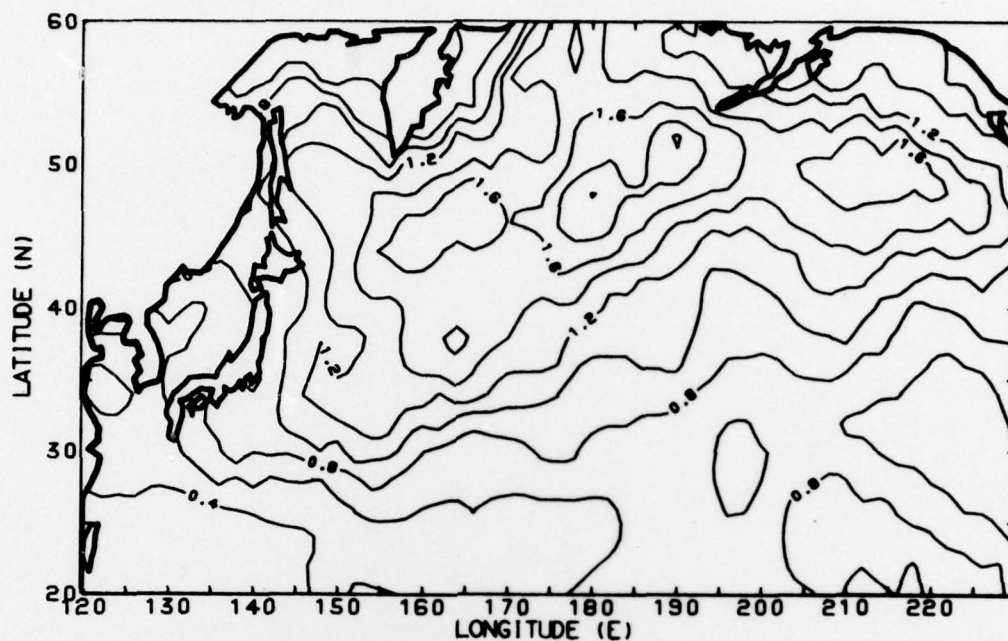
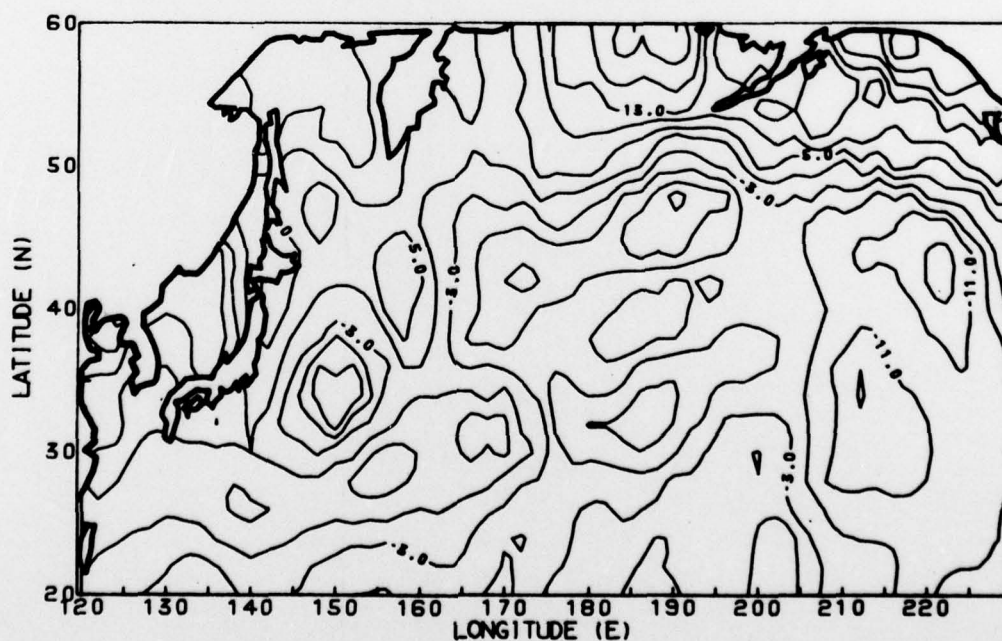


FIGURE 10.3 Monthly mean wind stress is the mean of 6-hourly wind stress at 10 meters calculated from FNWC wind data. Contour intervals are 0.2 dynes/cm<sup>2</sup>.

CURL OF WIND STRESS (10<sup>•••9</sup> DYNES/CM<sup>••3</sup>)

MAY 77





U STAR CUBED ((M/SEC)<sup>3</sup>)

MAY 77

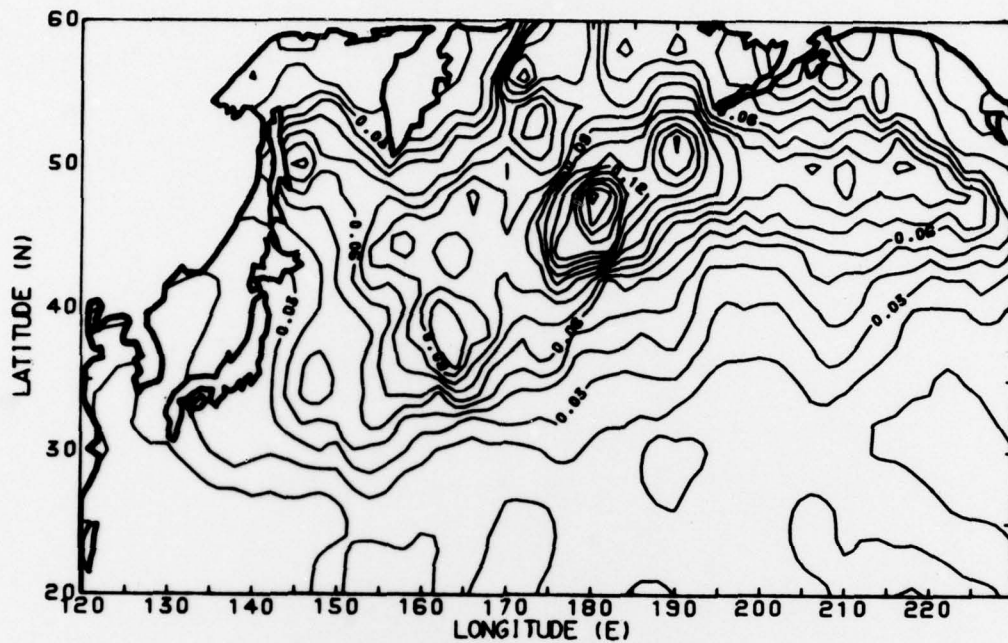


FIGURE 10.5 Monthly mean wind shear stress velocity cubed,  $U_*^3$  is the mean of 6-hourly wind shear stress velocity cubed calculated from wind speed at 10 meters. Contour intervals are 0.02 (m/sec)<sup>3</sup>.

SEA SURFACE TEMPERATURE (DEG.C)

MAY 77

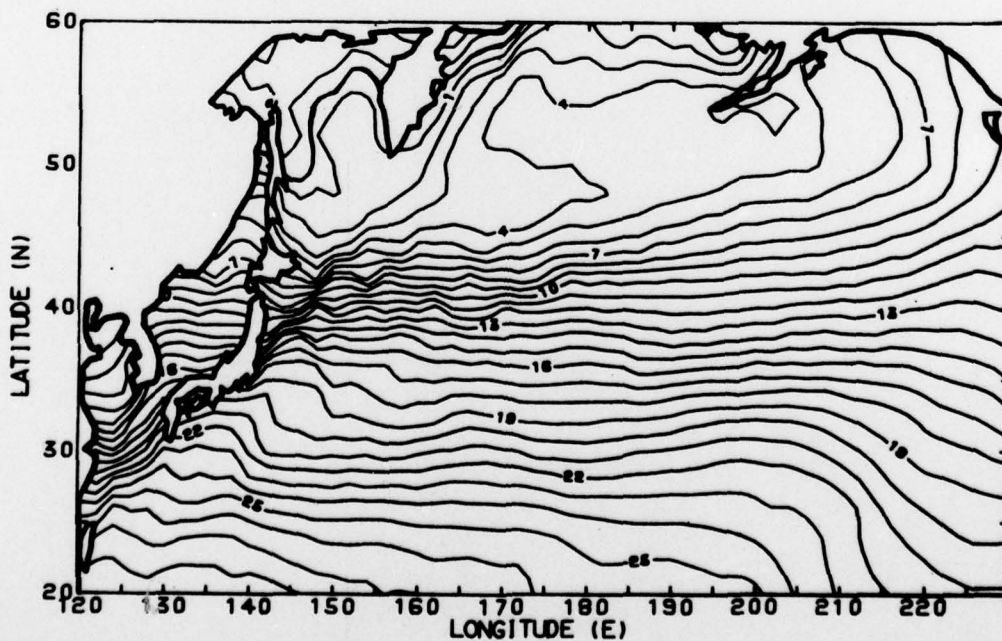


FIGURE 10.6 Monthly mean sea surface temperature is the mean of 12-hourly FNWC sea surface temperatures. Contour intervals are 1°C.



AIR TEMPERATURE (DEG. C) MAY 77

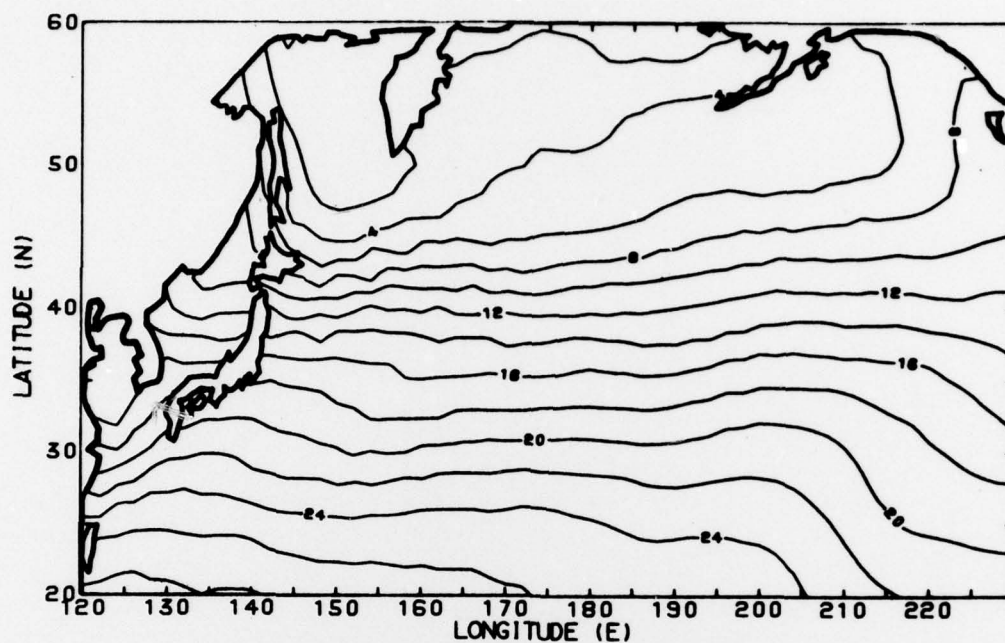


FIGURE 10.7 Monthly mean air temperature is the mean of 12-hourly FNWC air temperatures. Contour intervals are 2°C.

700 MB HEIGHT (M) MAY 77

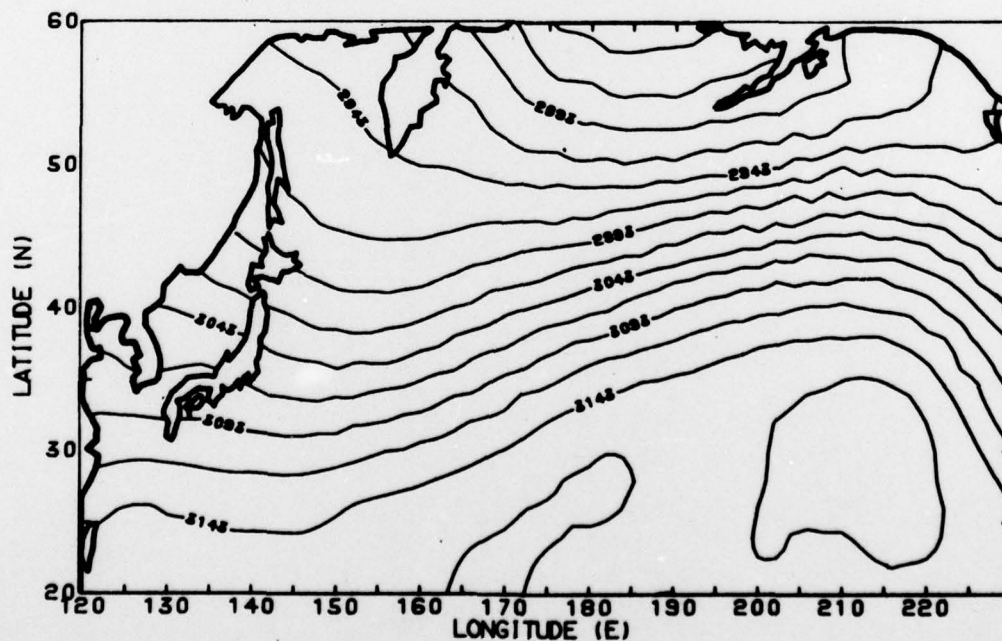


FIGURE 10.8 Monthly mean 700 mb height is the mean of 12-hourly FNWC 700 mb heights. Contour intervals are 25 meters.

VAPOR PRESSURE (MB) MAY 77

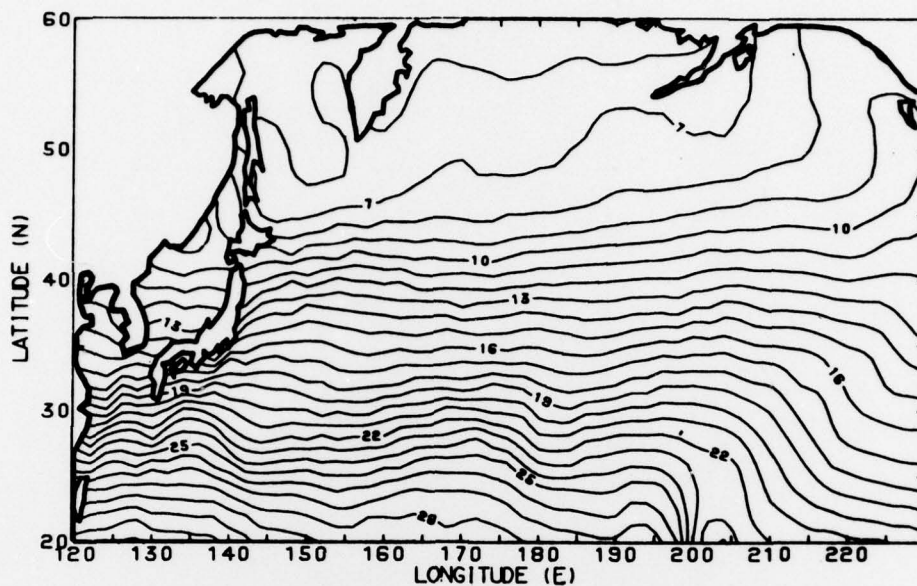


FIGURE 10.9 Monthly mean surface vapor pressure is the mean of 12-hourly FNWC vapor pressure at 19.5 meters. Contour intervals are 1 mb.

SENSIBLE HEAT FLUX ( $10^{-4}$  CAL/CM $\cdot$ 2 SEC) MAY 77

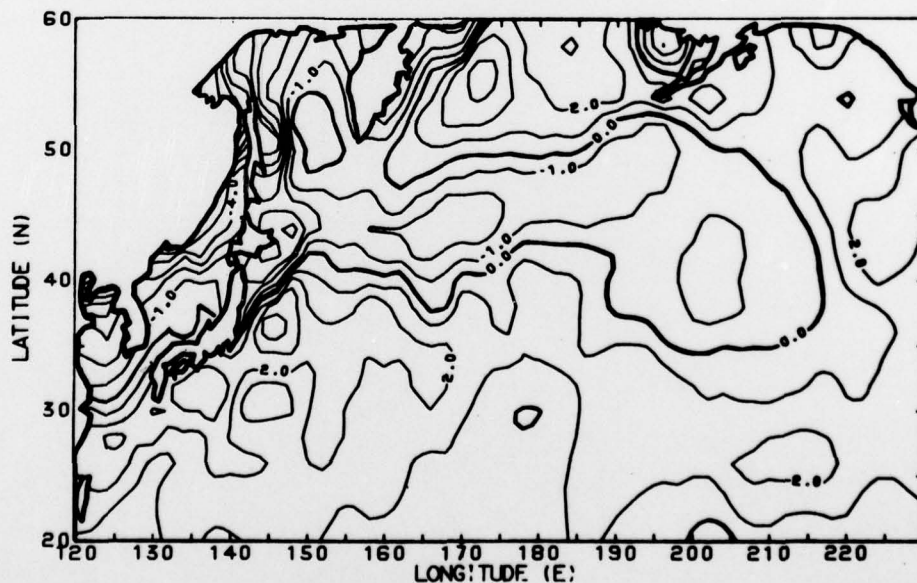


FIGURE 10.10 Monthly mean sensible heat flux (ocean to atmosphere) is the mean of 12-hourly sensible heat flux calculated from FNWC air and sea temperature and wind using a bulk formula. Isolines of zero heat flux are plotted heavily, and contour intervals are  $1.0 \times 10^{-4}$  cal/cm $\cdot$ 2 sec.

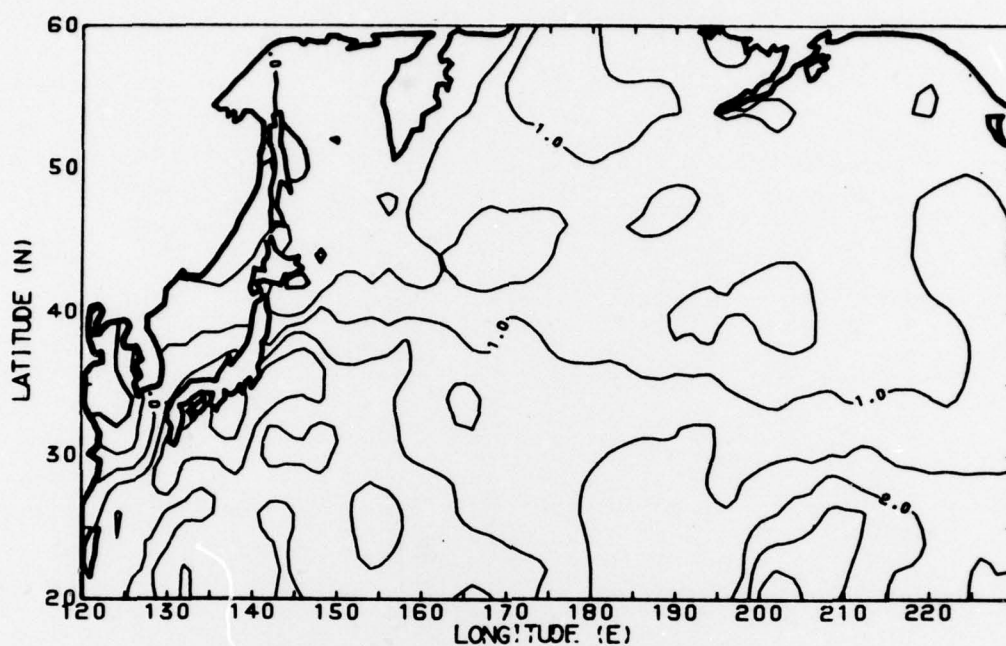
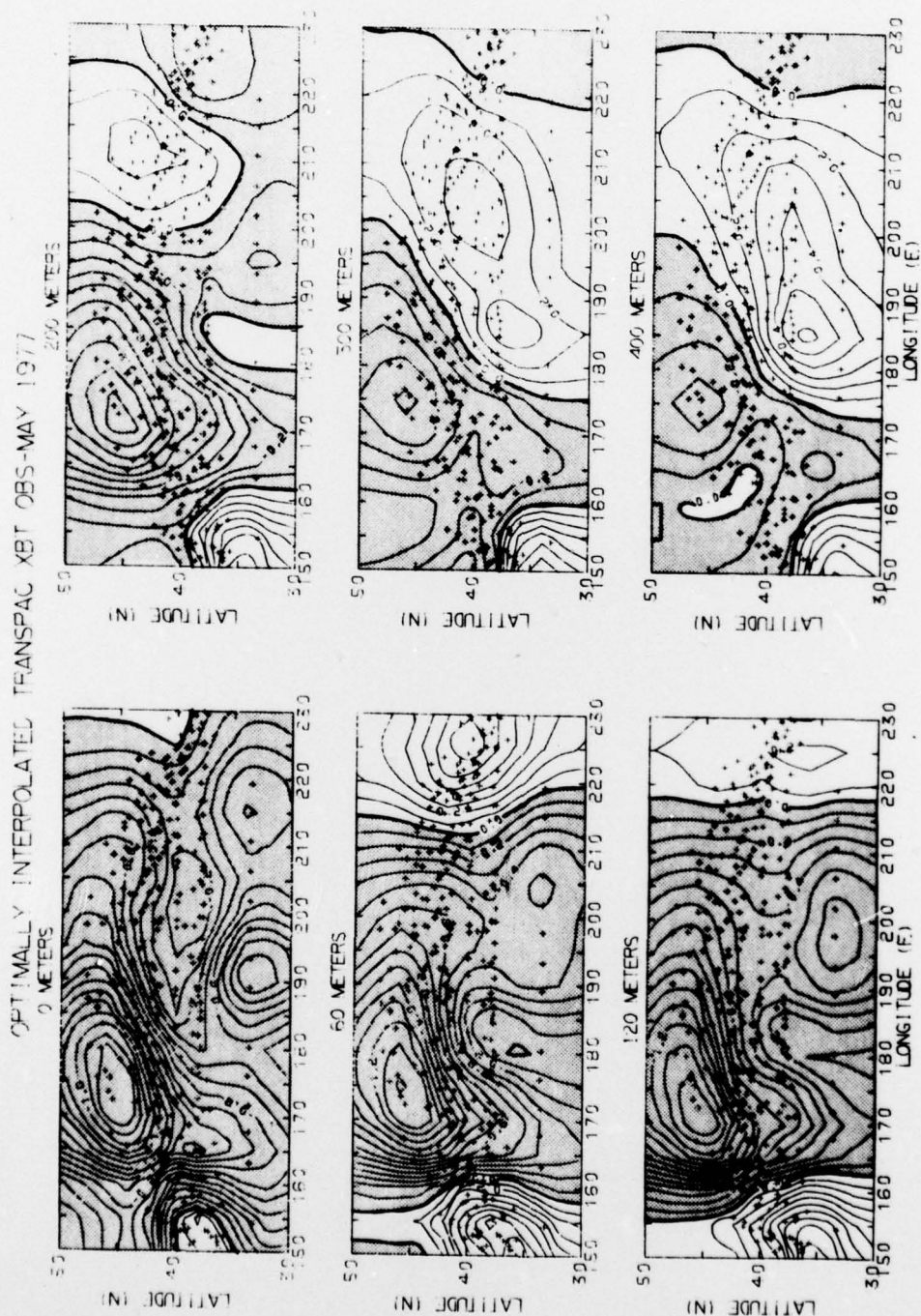


FIGURE 10.11 Monthly mean latent heat flux (ocean to atmosphere) is the mean of 12-hourly latent heat flux calculated from FNWC sea temperature, vapor pressure and wind using a bulk formula. Isolines of zero heat flux are plotted heavily, and contour intervals are  $0.5 \times 10^{-3}$  cal/cm $^2$  sec.





**FIGURE 11.** Monthly temperature anomalies (°C) contoured at fixed depths. Negative anomaly areas are hatched and isolines of zero anomaly are drawn heavily. The crosses mark the positions of the TRANSPAC XBT drops. Increments are in 0.1°C. (Prepared by W. White, SIO.)

May 1, 1977 to May 31, 1977

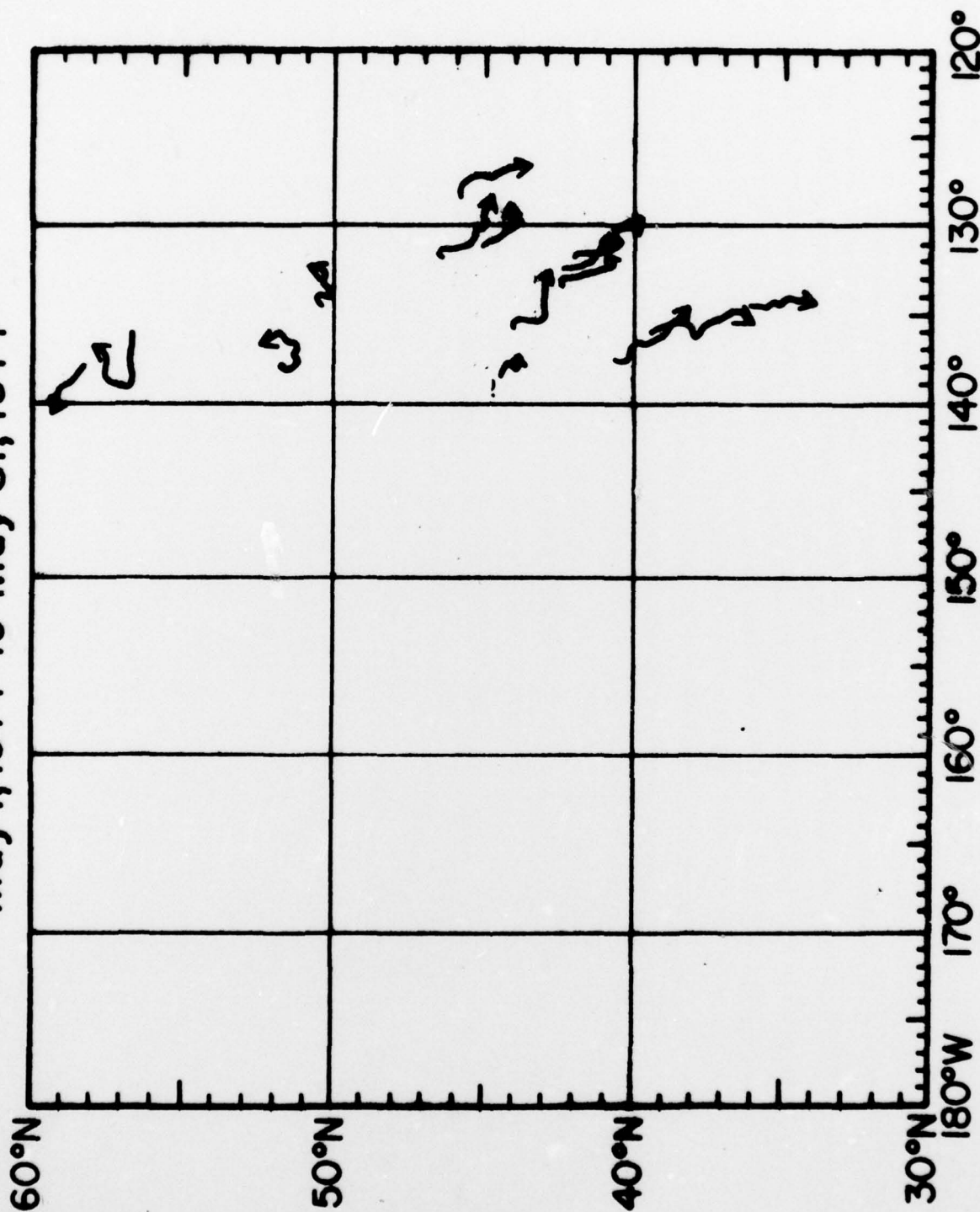


FIGURE 12. Monthly buoy tracks. Tracks are drawn from starting point at beginning of month to terminal point at end of month. Ratio of latitude to longitude is the same as in other figures (prepared by D. Kirwan, TAMU).